Adam Laubie.

PROGRESSIVE SERIES VOLUME I

PRACTICAL MANUAL OF DENTAL CASTING

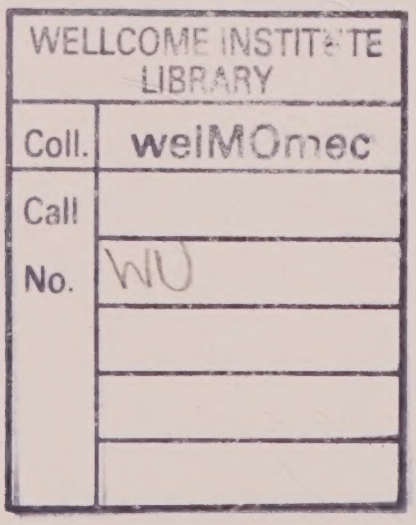
BEING THE
RECORDED EXPERIENCES OF
MANY ABLE AND EMINENT MEN
IN THE DENTAL PROFESSION

Profusely Illustrated

REPRINTED FROM THE DENTAL SUMMARY, 1909–1913

SECOND EDITION
REVISED AND ENLARGED

PUBLISHED BY
THE RANSOM & RANDOLPH CO.
TOLEDO, OHIO
1913



Printed by
The Express Publishing and Printing Co.
Toledo, Ohio
1913

PREFACE

IN PREPARING THIS BOOK and offering it to the dental profession, the sole object has been to place within easy and convenient access, in concise, permanent form, the best thoughts of the most expert and successful casting men, together with records of their results, as they have been expressed through the pages of THE DENTAL SUMMARY during the past three years.

To this has been added historical articles, covering the origin and progress of the casting art as applied to dentistry, showing, step by step, the really wonderful advancement that has been made and the immense usefulness of that art to the dental profession.

The book will be found in line with modern methods. Every phase of the casting process has been touched upon, some of them worked out exhaustively; and, in its pages, will be found much practical advice and instruction that cannot fail to be helpful to all, while, for the beginner, it would seem to be altogether invaluable.

The idea of profit has not been considered by the publishers. The price at which the book is offered ought to convince everyone of that fact. The preservation of the knowledge contained therein and the placing of that knowledge in the hands of the profession has seemed a sufficiently high ideal of service to warrant the labor and expense involved.

THE PUBLISHERS.

PRACTICAL MANUAL OF DENTAL CASTING

ANCIENT ORIGIN OF DENTAL CASTING

By L. W. Strycker, New York.

The object in preparing this article is not to change public opinion nor to bring discredit upon anyone. Rather is it to enlighten the dental public upon a subject concerning which much erroneous information is extant, in the hope that others may take up the subject and work it out for the benefit of all, as did the Old Masters in an age when time was nothing and art everything.

The facts herein laid before the public have been gained by the study of old text-books as well as from the references to current authorities that are given. Being in possession of this knowledge, the writer looks upon it as his duty to give it out. By withholding it, he would lay himself open to the charge of secretiveness, and bring dishonor upon himself in later years.

Of course, only the most brief outline can be given in such an article. Any attempt to print all of the valuable information that has been gained by this investigation would be entirely out of the question, as volumes would be required to reproduce it. The books themselves should be read by every man who is interested in the subject sufficiently to take the time necessary. For those who have not the time at their disposal, this brief resume has been prepared, and is here offered for what it may be worth to the profession.

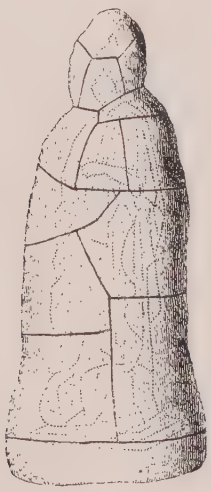


Fig. 1—"Malaga a la Francaise," or piece casting. The model completed.

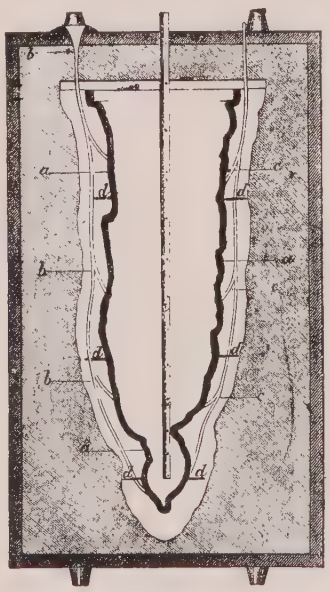


Fig. 2—Piece casting; the model "inverted."

The most cursory investigation of the authorities given will convince any man that casting by the so-called "modern" processes is by no means new; that it is simply a neglected and almost forgotten art. In taking up the subject we must go back to the most ancient text-books and records, the older the better. The methods that we are now so eager to learn are handled by the Old Masters in the founding art with most satisfactory clearness and particularity of detail. Especially is this true of the "Cire Perdue" or disappearing model or "wasting wax" process, which was known and in common use almost countless ages ago.

This also is true of two of the methods for forcing the metal into the mold in common use today—centrifugal force and pressure. The centrifugal method is first mentioned in the old books, and we reproduce an illustration of one of these ancient centrifugal casting machines (Fig. 4). This was used for casting bronze busts and other objects of art.

Later the mechanical pressure air-pressure machines were invented and became well known. Illustrations are given of these ancient devices (Figs. 5 and 7).

The earliest account of the casting of bronze by the cire perdue or disappearing wax model process is given in *Knight's American Mechanical Dictionary* as 2230 B. C., and has to do with a reference by Herodotus and Diodorus to massive bronze statues that were set up in the Temple of Belus, in Babylon.

Fig. 3—"Cire Perdue," or Waste-Wax Method. Identical with Modern Disappearing Model Methods.

Fig. 4—Ancient Centrifugal Casting Machine. Date unknown.

In Isaiah, xliv, 12, written about 712 B. C., is an account of the making of the golden calf by Aaron, supposed to be several centuries earlier, or about 1491 B. C. "He," Aaron, "received then the golden ear-rings of the people at their hands, and fashioned it with a graving tool, after he had made of it a moulten calf."

The Colossus set up by Nero the Roman emperor, before his golden house, near the site of the Temple of Venus at Rome, was a bronze figure of himself, the work of Zenodorus. This was also cast by the cire perdue, or disappearing wax model process.—*Knight's American Mechanical Dictionary.*

Myer's Ancient History tells us that bronze was cast by the Greeks about the eighth century B. C., which also speaks of Lycippus as being renowned for his works in bronze.

This knowledge, that the ancients were in possession of the greatest skill in the art of casting metals, lets a flood of light in upon some of their most famous productions now preserved in museums. Until this was learned concerning them, the wonder was how such marvelous reproductions could have been made with the crude methods supposed to be at their command. The use of the disappearing wax model, invested and cast upon a large scale, it is true, but in precisely the same manner as that now employed in dentistry, makes all that clear.

"The great bronze lions of the Nelson Monument in London are a sad example of the present low state of the founder's art. Coarse sand casting in England now takes the place of the delicate cire perdue process."—*Encyclopedia Brittannica*, Vol. 14, page 79.

The full-length recumbent effigies of Henry III and Queen Eleanor at Westminster, cast in bronze by this process (disappearing wax model method) are equal, if not superior, in artistic beauty to any sculptor's work of the same period." (End of the thirteenth century.)—*Encyclopedia Brittannica*, Vol. 14, page 77.

"The great candelabrum in Seville cathedral is the finest specimen of sixteenth century metal work in Spain. It is mainly the work of Bart Morel, in 1562. It is cast in bronze, enriched with delicate scroll-work, foliage and numbers of well-modeled statuettes, cast by the disappearing wax model method."—*Encyclopedia Brittannica*, Vol. 14, page 76.

"In Work-Shop Receipts," published by E. Spon, London, page 221, is decribed the two methods of wasted-wax casting: 'Malaga a la Francaise,' or piece casting. (See Figs. 1 and 2.) The other process is that known as cire perdue, or waste-wax pattern. It is the more ancient of the two and has been practiced from time immemorial by the artists and artizans of Italy." (See Fig. 3.)

"The mention of molds for the casting of wax figures is ascribed to Lysistratus, about 328, B. C."—*Knight's American Mechanical Dictionary*, Vol. 2, p. 1459.

"Suppose a small ornamented vase were to surmount the pillar; the founder would prepare the pattern for this in a more elaborate manner. He would first mold it in *wax*."—*Chambers' Encyclopedia*, Vol. 4., p. 454. Published 1870.

"An old method which is still employed in Italy is to make a core composed of potter's clay, brick dust, cow's hair or some other composition, and over this to model the figure in *wax*; then the other mold is formed on this of some composition of which loam is the principal part. The whole is then dried, and baked, in an oven, *until the wax is melted and cleaned, and the mold is rendered sufficiently porous.*"—*Amn. Cyclopedia*, Vol. 4, p. 85. Published 1875. (The italics are mine.)

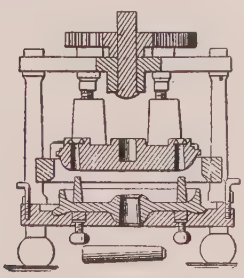


Fig. 5—Pressure Casting Machine, about 1819.

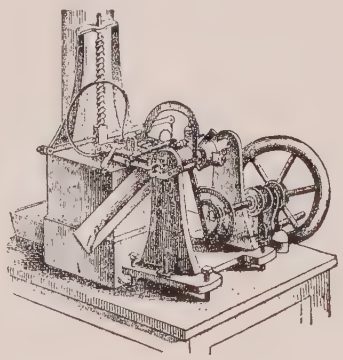


Fig. 6—Type Casting Machine. Casts by pressure.

"Castings of *great delicacy* are produced by using models of *wax*. These are embedded in molds of finely-ground earth, which are then heated *red hot*. The mold is baked and THE WAX DISAPPEARS; and the metal, when poured, exactly takes its place."—*Knight's Amn. Mech. Dict.*, Vol. 1. Published 1880.

The most clearly written directions for using the disappearing wax model method are given on page 72, vol. 14, *Enc. Brit.*, published in 1891, by R. S. Peale Co., Chicago. These directions were reproduced almost word for word, sufficiently so to warrant the assertion that they are identical, in the first directions given to us for the casting of inlays and the like; particularly where we are told to "use an investment mixed with water to the consistency of cream, and apply with a brush, until a coating is formed over the wax," etc. Here is the quotation:

"METHODS OF MANIPULATION IN METAL WORK.

"Gold, silver and bronze may be treated in various ways, the chief of which are (1) casting in a mold, (2) treatment by hammering and punching (swaging; French repoussé). The first of these, casting, is chiefly adapted for bronze, or in the case of more precious metals, only if they are used on a very small scale. The reason for this is that a repoussé relief is of much thinner substance than if the same design were cast, even by the most skilful metal worker, and so a large surface may be produced with a very small expenditure of valuable metal.

"Casting is probably the most primitive method of metal work. This method has passed through three stages, the first being represented by solid castings, such as are most celts and other implements of prehistoric times; the mold was formed in clay or stone, and the fluid metal was poured in until the hollow was full. The next stage was, in the case of bronze, to introduce an iron core, probably to save needless expenditure of the more valuable metal. The British Museum possesses an interesting Etruscan or archaic Italian example of this primitive device. It is a bronze statuette from Sessa, on the Volturus River, about two feet high, of a female, standing, robed in a close-fitting chiton. The presence of the iron core has been made

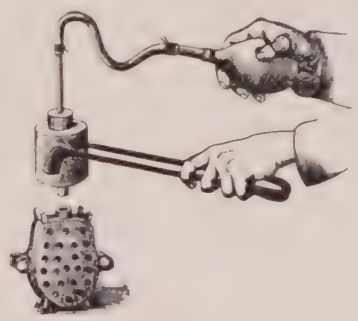


Fig. 7—Dr. Carroll's Air Pressure Casting Machine, 1885-6.

visible by the splitting of the figure, owing to the unequal contraction of the two metals.

"The third or last stage in the progress of the art of casting was the employment of a core, generally of clay, around which the metal was cast in a mere skin, only thick enough for strength, without waste of metal.

"The Greeks and Romans attained to the greatest possible skill in this process. Their exact method is not certainly known, but it appears probable that they were acquainted with the process now called cire perdue (wasting wax method), the same as that employed by the great Italian artists in bronze, and *still unimproved upon, even at the present day.* Cellina, the great Florentine artist of the sixteenth century, has described it fully in his *Trattato della Scultura.* If a statue were to be cast, the figure was first roughly modeled in clay, only rather smaller in dimensions than the future bronze; all over this a skin of wax was laid and worked by the sculptor's modeling tools to the required form and finish. A mixture of pounded brick, clay and ashes was then ground finely in water, TO THE CONSISTENCY OF CREAM; and successive coats of this mixture were then applied *with a brush,* until a second skin was formed all over the wax, fitting closely into every line and depression of the modeling. Soft clay was then carefully laid on to strengthen the mold, in considerable thickness, till the whole statue appeared like a shapeless mass of clay, around which *iron hoops or rings* were bound to hold it all together.

"The whole was then thoroughly dried and placed in a hot oven, which baked the clay, both of the core and the outside mold, AND MELTED THE WAX, which was allowed to run out through small holes made for the purpose. The mold was now ready for casting," etc.

So here we have a fairly accurate and connected history of THE DISAPPEARING MODEL PROCESS, and will next take up casting machines in the use of which pressure was employed.

Our cut, Fig. 4, shows a primitive centrifugal machine, used for casting a bust.

Knight's Amn. Mech. Dict., Vol. 1, published 1880, says: "In the English patent, No. 3197, January 28, 1809, the molds for casting are upright and are made to revolve on pivots or spindles. The centrifugal force causes the metal to fill up all parts of the mold." It also says: "In an American patent of 1857 the car wheels are revolved (while being cast) so that the first metal poured is made to form the tread of the wheel, and the second portion to form the body of the wheel," and further: "In Bessemer's patent the metal is poured into fast-revolving cylinders, the rapid rotation of which causes the metal to collect on the inside of same, when it is allowed to cool. It is then split open and rolled."

The same volume then speaks of pressure casting machines. "To obtain the best results in compact metal castings, destitute of porosity, and with sharp definition on the angles and ornaments, casting under pressure has been devised. See Hollingrake's English patent, 1819."

Following this it gives a drawing of the machine, which we have reproduced as Fig. 5. Going farther, it says:

"In one case the molds are so arranged that the top part serves as the follower of a press, and is operated on by screws. The top part fits closely into the matrix and is provided with ingates for the metal, which are closed by slides when the mold is full. The *pressure* is applied to the metal while in a melted state, with *sufficient force to expel the air* and *gas from and solidify the metal.*"

Then it speaks of Smith's process of compression casting. The face of the article is covered with a preparation of potter's clay, the model is withdrawn by a little india-rubber suction apparatus, "and we have an exact fac-simile, ready, when dried, to be cast from. Nothing can exceed the beauty of the result by casting the metal under pressure in the mold. Thus prepared, screws and nuts which never had a tool put on them, leave nothing to be desired in the way of accuracy and completeness."

On page 604, describing the term "compression-casting," we find this: "A mode of casting bronzes, etc., in molds of potter's clay, under a pressure which causes the metal to flow into the delicate tracery left by the pattern. This work nearly approaches the work of the graver and chisel. It is especially used in casting house-builders' hardware, letters, numbers for houses, etc."

In Vol. 2, page 1462, is the following: "Soft and perishable objects may be so molded as to produce a single casting by one of the several following methods, which are adapted to the procuring of castings of small animals, insects, flowers, feathers, ferns, sea-weed, wax models, etc:

1. Support the object in the center of a small box, by needles; one or two should be sufficiently large to form ingates. Fine river mud is dropped into the box and shaken around so as to adhere to the object. When partially dry, a coarser grade of silt is thrown in until the box is filled. The needles and ingate wires are

withdrawn, the mold burned to reduce the object to ashes, which are shaken or blown out, when the mold is ready for casting.

2. Another method is to take the object itself or a *wax model*, such as that of a flower, and suspend it in a box while plaster of Paris is carefully poured around it. The application of heat causes the object to burn *or the plaster to absorb the wax;* or, if the latter be in excess, it may be poured out. The strings by which the object was suspended are withdrawn and the mold is ready for casting. This plan was adopted in casting the feather of the equestrian statue of George III, at Pall Mall, London; and specimens of ears of wheat, flashy flowers, such as coxcomb, and other beautiful objects."

We are indebted to the Italians and French of the fifteenth, sixteenth and seventeenth centuries for *safe* molds; the ones mentioned above are termed waste molds.

On page 2312, Vol. 3, this work describes the casting of busts and statuary. The print is very fine and the article would fill a single issue of any of our dental journals. The article was written in 1844. The description in part follows:

"The present system of statuary casting is as follows:

1. Take a cast in plaster sections, which together form a matrix.
2. Cover the inside of these sections with a *shell of wax.*
3. Place the sections together so as to form a mold.
4. Fill the inside with clay or slush, so as to form a core with supports to sustain it independently of the mantle.
5. Remove the plaster sections, *the wax adhering to the clay.*
6. Work up the wax surface into complete form by hand.
7. Coat with porous clay composition to form mantle.
8. *Bake in a furnace, melting or burning out the wax.*
9. Run the metal into the baked clay mold.

The church of St. Isaac at St. Petersburg is decorated with a large number of statues and figures in relief obtained by this process."

On pages 2674-2675, Vol. 3, the type-casting machine is described, showing the Bruce machine, and says that in 1850 a French invention by M. Didot was designed to cast about 200 types at once, requiring about twenty seconds. Pressure brought to bear upon the molten metal forced it into all the recesses of the molds.

Westcott's machine, U. S. patents 115, 796, June 6, 1871; 169215 and 169216, October 25, 1875, casts and sets the type by pressure on the molten metal.

In the *American Cyclopedia*, Vol. 13, p. 791, published 1875, we find the following: "There are difficulties in making large, thin vases, which have been overcome at Sevres by the employment of atmospheric pressure and exhaustion. A plaster mold is used, and the cast is made either by covering the mouth of the mold and forcing air into the interior, or by exhausting the air through the porous plaster by means of an exterior air-tight case."

The Century Dictionary and Cyclopedia, Vol. 1, p. 849, published 1889, in describing the meaning of the words "Compression Casting," uses these words: "A method of casting in molds of potter's clay, with sufficient pressure to force the metal into the most delicate tracery left by the pattern. It is used in casting letters, stamps, house numbers, house builders' hardware, etc." Further on it defines the meaning of the words "Casting Press" as "a press in which metal is cast under pressure."

Chambers' Encyclopedia, Vol. 9, p. 606, published 1870, says that various attempts were made during the early part of the century to cast type by machinery,

but that the first successful type-casting machine was invented by David Bruce, Jr., of New York, and patented March 17, 1838.

The first type-casting machine was patented in the United States in 1828 by William M. Johnson, but it did not produce good types. The patent was sold to George Bruce, and the machine was used by him until 1845. David Bruce meanwhile patented another machine, 1843, with improvements two years later, which gave entire satisfaction and is now in general use in American type foundries.

This same volume gives an illustration of a type-casting machine, and describes it as follows:

"A type-casting machine consists first of a small melting-pot, which contains the molten metal. In the interior of the pot is arranged a FORCING PUMP and a valve for admitting the metal under the piston, and also for preventing of the return of the metal into the mass in the pot when the piston is depressed, and thus securing the full force exerted upon the piston being transmitted by the piston to the molten metal under it, and *forcing it through a narrow channel to the mould*," etc.

The Century Dictionary, Vol. 3, p. 2531, in describing pressed glass, says: "Glass while in a molten state, is brought to shape in a mold by a plunger."

The Encyclopedia Brittannica, 9th edition, Vol. 18, p. 481, describes a method of casting steel ingots employed by Sir Joseph Whitworth, by applying hydraulic pressure to the metal in the mold until it solidifies, which "has been adopted by the inventor with great success in the prevention of blow-holes and similar imperfections."

Now, let us see what all this has to do with dentistry. (See Fig. 7.) This illustration shows a machine devised by Dr. C. C. Carroll, of Meadville, Pa., in 1885 or '86, for casting plates by the pressure process. Dr. Carroll turned over his invention unreservedly to the profession, the following paragraph appearing in the copy of Directions given with the machine:

"These goods are placed before the profession on their merits, upon the most liberal terms, without any charge of license or royalty upon the patents by which they are covered, and by the use of which all other patents for crowns, bridges, etc., are evaded."

He also gives full directions for casting, and says: "Maintain the pressure about five seconds to give the molecules of metal time to arrange themselves *under pressure*. Otherwise there may be small pits over the surface of the denture."

He further says: "Mold upon the teeth in thin paraffine wax the crown or bridge that is intended to be worn," etc. It seems fair to assume that he made his abutments and no doubt his inlays in the same manner.

Now, let us turn to periodical literature on the subject:

In the account of the meeting of the First District Dental Society, State of New York, Tuesday evening, March 13th, 1894, at the New York Academy of Medicine, published in the *Dental Cosmos*, Vol. 36, No. 5, May, 1894, appears the following:

"Dr. George F. Reese, of Brooklyn, N. Y., demonstrated the method of adjusting his gold alloy cast crown:

"A right superior lateral root was selected in a lady patient. He had the root already prepared; then the artificial crown, which was a plain rubber tooth, was ground to fit to the root and gum; next a piece of platinum wire, coated with gold the length of the root, was hammered flat at the exposed end and bent into a foot shape. It was then fastened by wax to the artificial crown and an impression of the root was taken. This was put in and removed a number of times, the surplus

taken off with a heated spatula until adaptation and contour were correctly obtained, down to the finest detail. It was then placed in cold water to harden the wax and tried in again. Everything being found satisfactory, two points of wax were put on the back of the crown, which was then invested in plaster of Paris. After hardening the wax was grooved out, the matrix heated, and the wax melted out by a fine stream of boiling water. Two pockets were then made, one being the pouring, the other the vent gate. This was again invested in plaster, which was now ready after hardening and standing a couple of hours to be put in the drying oven. When dry, which is shown by the mirror test, the gold alloy was melted and heated until it turned a purplish tint, when it was ready to cast.

"The doctor, after finishing, proceeded to insert a duplicate crown. By so doing it was shown that the crown fitted perfectly. He then permanently fastened it by drying out the root and coating the crown root with oxyphosphate cement."

Page 269 of the April, 1889, *Dental Cosmos*, shows us the following: "Dr. Reiss, of Brooklyn, showed a specimen of an improved porcelain crown."

Page 293, same number: "Dr. J. N. Crouse, by permission, called attention to the Dental Protective Association. He said that it was necessary to act at once, as they must have money now to carry on the fight against The Tooth Crown Company."

In concluding I wish merely to say that I believe in giving credit where credit is due; and that to me it seems that credit is, in this case, undoubtedly due to the man who devised the crown and bridge that has stood the test of time, and promises to stand indefinitely, rather than to one that has done nothing more than to revive an art that has been practiced in all branches of metal work from time immemorial, that probably is as old as man's knowledge of metals, and for which, at this late day, great claims for originality are made.

As to the kind of work that is being done in dentistry along that line, the average result is described by Dr. Rhein, of New York, who, at a recent dental meeting, spoke of the average inlay as "A floating island of gold in a sea of cement."

Unless the average practitioner shall learn speedily to cast better inlays and insert them with greater skill, there most certainly is grave danger that the inlay method will bring discredit upon the entire profession.

EARLY ATTEMPTS AT INLAY CASTING

By C. V. Vignes, D.D.S., New Orleans, La.

Some four years ago, before the present methods of gold inlay casting came in vogue, and before I had heard of cast gold inlays, I made some attempts at casting gold in a mold, a description of which I believe will be of interest.

While the method I used was somewhat different from that now employed, and while I was to a great extent unsuccessful, yet I was fortunate enough to cast a fairly good inlay. And having been so close to the right way, I feel pardonably proud of the pioneer work that I did in that direction, although it was abandoned as impracticable, even unsuccessful.

Working upon the idea that the duplicating in gold of wax models of missing parts of teeth would greatly facilitate our work, I made the following experiments with the doubtful success above mentioned:

After obtaining an impression of the cavity in pink paraffin and wax and carving to contour, as is at present done with the special inlay wax, I attached a small rope

of the same material to the model to form a sprue, and proceeded to invest the case. The investment was made small and without the ring that is now used in investing inlay cases. After the setting of the investment, a funnel-shape depression was made around the sprue.

So far I was on the right road to the successful casting of the gold inlay; but my idea of the sprue was not to force the melted gold through it, nor was the carved funnel leading to the sprue to be used as a crucible in which to melt the gold prior to its being forced into the matrix formed by the disappearance of the melted model; but the funnel and sprue were made to facilitate the working into the matrix of gold filings. My idea being that if I could fill the matrix with gold filings and heat the investment (which was, for that purpose, made very small) to the melting point of gold, that I would attain the result sought for; but in this I was mistaken, for I succeeded only in obtaining a globule of gold.

Following up the first idea, I thought that if I could put a gold lining on my model that I would meet with ultimate success. To do this in a simple manner and to obviate the necessity of burnishing foil into the cavity, after obtaining my model, I rolled it into gold filings, reinserted it into the cavity, reburnished it and proceeded as before. By this method I was more successful than in my first attempt. Failure was due to the fact that not enough of the gold filings investing the model would adhere to the investment to give the complete metallic lining looked for. The casting, while it had the general shape of the cavity, was too defective to be put to practical use. Hence the abandoning of the idea.

TECHNIC OF A CAST GOLD INLAY

By A. F. Miller, D.D.S., Sandusky, Ohio

A cavity in the disto-occlusal surface of an inferior, right first molar was prepared for a cast gold inlay in the following manner: The disto-buccal and disto-lingual margins extended to beyond the point of contact. All sharp angles and margins removed, except the gingival portion at which point the surface was dressed off with a fine grit, hard rubber safety, separating disk. This disk being flexible can be extended under the free margin of the gum with little discomfort to the patient. Excavation was extended to the occlusal center, cutting out the sulcus where carious and so formed that the wax impression can be freely withdrawn. The above method of cavity formation presents two advantages: first, as retaining points for the inlay; second, the removal of all sharp angles and margins that would be broken down in the mold by the action of the cast metal against them, thus preventing proper adaptation of the inlay to the cavity. This cause is often erroneously attributed to shrinkage or expansion of the metal. Gently warm the wax for the impression over a flame and press it into the cavity with the finger or flat burnisher, instructing the patient to close the mouth for occlusion. Trim off all excess contouring where indicated, burnishing the wax over the approximal edges and carving flush to the occlusal margins. Chill the wax and carefully remove from the cavity with a small excavator. Carve a horizontal groove in the wax to give vertical anchorage to the inlay. This can be done more conveniently after the sprue wire is inserted. Heat and insert sprue wire in the approximal aspect of the model and secure it in its position in the sprue former with the point of a wooden tooth pick.

The first investment consisted of a small quantity of the Detroit investment compound applied with a soft hair brush, covering the model uniformly to about

1-8 inch thick, extending it down over the sprue former. This is then invested with a second mixture of equal parts of yellow molding sand and plaster, a little sodium chloride added to hasten setting, and flasked in a split rubber tube secured from spreading at the bottom by the flange at the sprue former and by an open metal ring at the top.

After setting, the flask is removed and the wax and moisture eliminated by laying the investment horizontally on a wire screen over a flame on a case-heating stove and applying the brush flame from the blow-pipe on and over the end opposite the gate. This procedure required only fifteen minutes from the time the investment was set, including the casting; the inner investment showing no appreciable change from the high temperature to which it was rapidly subjected.

It is claimed by the demonstrator that the outer investment serves as a protective envelope to the inner against unequal expansion or contraction, thus resulting practically in an inlay uniform and without shrinkage.

The instruments used in preparing the cavity were Black's rapid excavator chisels, a German short, right angle, fissure bur, two sizes, and fissure stone for right angle.

The inlay was cast on a vertical centrifugal casting device designed by the demonstrator.

The inlay was seated, and cemented in the cavity to which it showed perfect adaptation at every point.

PORCELAIN CROWN WITH CAST GOLD BASE

By W. A. Sanderson, D.D.S., Pittsburgh, Pa.

To make a porcelain crown with a cast gold base, proceed as follows:

Select a tooth of any make desired, either fixed or detached post.

Prepare root in usual manner, with a short bevel in labial, and a longer bevel in palatal direction. Grind crown roughly to place, leaving plenty of space between the crown and the end of the root on the palatal side. Mold a small piece of soft inlay wax about the pin and press to place or nearly so. Remove and trim away surplus wax. Warm slightly and press home. After again removing, be careful to remove all wax from face of porcelain, wipe it away with cotton saturated with alcohol or chloroform. If using detachable post crown, remove the porcelain, attach the sprue wire at the thickest point of the wax, viz., at the palatal heel. Also attach another wire (24 or 25 gauge) at a point as near the labial surface as is possible. When investing pass the second wire through a hole made in the side of the bucket for that purpose. After the investment has set, remove the sprue and both wires. The object of the second wire is to provide an escape for the air or gas which would otherwise be confined in the mold.

It will be found difficult to cast the gold to a thin edge without this provision for the escape of gas.

When using a fixed post crown, remember that it is impossible to overheat with natural gas and blow-pipe, and the hotter the case the less liable is the porcelain to check.

After casting, smooth with paper discs and polish. The result will be a perfect adaptation to root and crown. In cases of enlarged root canal the wax and consequently the gold can be forced up on the post, thus giving extra strength and a perfect adaptation of the post to the root.

SHRINKAGE OF THE INVESTMENT—INVESTING THE WAX MODEL SO AS TO PROCURE THE MINIMUM POSSIBILITY OF DISTORTION

By C. J. Clark, D.D.S., Chicago, Ill.

The instability of the investment used for the purpose of forming the mold into which the molten metal is forced, has been considered the prime factor in contributing to the cause of many failures in the process of casting gold under pressure. It being charged—

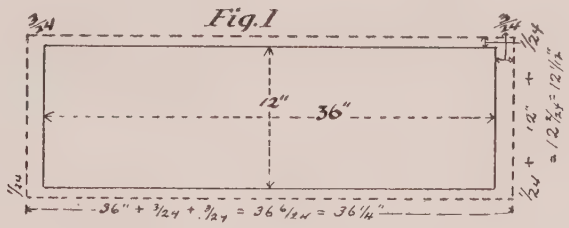
1st. That the investment being porous, allows the pressure to envelop the molten metal in the mold, causing distortion and augmenting the shrinkage of the metal.

2nd. That the investment is not of sufficient integrity to withstand the contact of the molten metal when considerable pressure is used to force the molten metal into the mold.

3rd. That the investment shrinks, thereby causing a distortion of the mold.

THE POROSITY OF THE INVESTMENT

The porosity of the investment can be considered as a detrimental factor only in cases where the force used to drive the metal into the mold is an expanding gas and in an extensive piece of work, the pressure not being restricted to exert its force on the metal in the crucible, but being free to penetrate the investment by virtue of



its porosity, and to envelop and attack the metal on all surfaces, thereby causing compression from several directions, and must exert a deleterious influence on the finished product.

Before a cast is made the mold contains air, and when the metal is forced into the mold, it must displace the confined air and expel it into the porous investment, where it meets and offers opposition to and impedes the free expulsion of air from the mold, thereby retarding the ingress of the metal into the mold.

THE INTEGRITY OF THE INVESTMENT

When we consider the extreme fluidity of the molten metal, if judgment is exercised, there is no danger from this source; for the molten metal is in such a state as to be incapable of making any impression on the walls, angles and convolutions of the mold as it might if in a more coherent condition. The direct opposite is true, the walls, angles and convolutions of the mold, imprint their every reflection on the surface of the molten metal, and unless an excessive force be used, there is no danger of distorting the mold from the impact of the molten metal.

THE SHRINKAGE OF THE INVESTMENT

Let us suppose Fig. 1 to represent a bar of iron 36 in. in length and 12 in. in width, and of equal density throughout the mass. Under a definite degree of heat it will expand to the extent of 3-24 of an inch in each direction from its mean line

Fig. 2

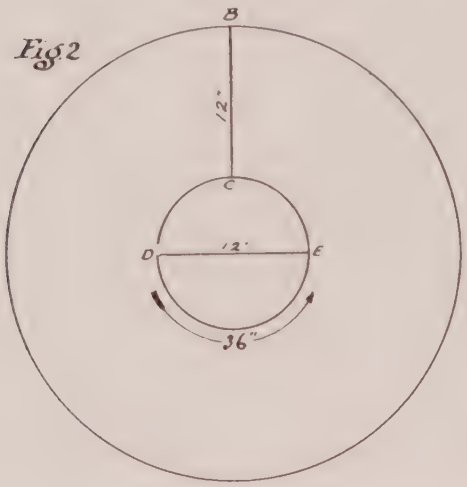
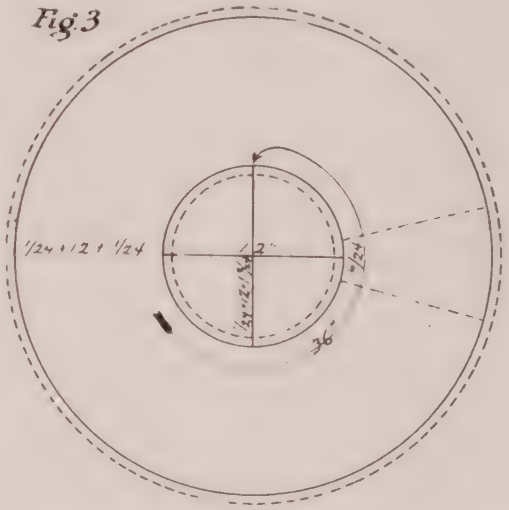


Fig. 3



of linear expansion and 1-24 inch in each direction from its mean line of lateral expansion. The dimensions of the bar would then be 36 + 3-24 + 3-24 = 36 6-24 + 12 + 1-24 + 1-24 = 12 2-24 or 36 6-24 + 122-24 as represented by Fig. 1. Now let us suppose that the same bar is bent into the form of a ring, the inner circumference of which would measure 36 in. with a consequent diameter of approximately 12 in. (The diameter of a circle being determined by dividing the circumference by three and a fraction, the fraction being omitted to simplify.) The dimension of the outer circumference is immaterial. Now if the same definite degree of heat be applied as was to the straight bar, we will discover that while the dimension of the outer circumference has increased, the dimension of the inner circum-

Fig. 4

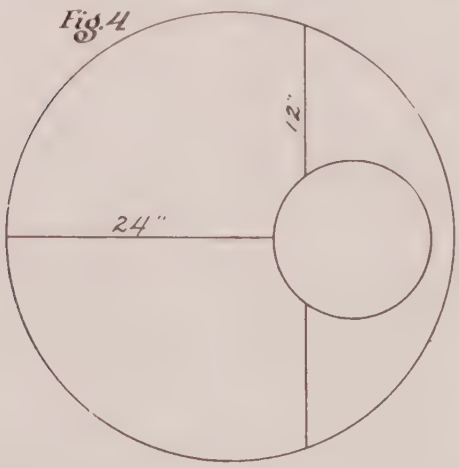
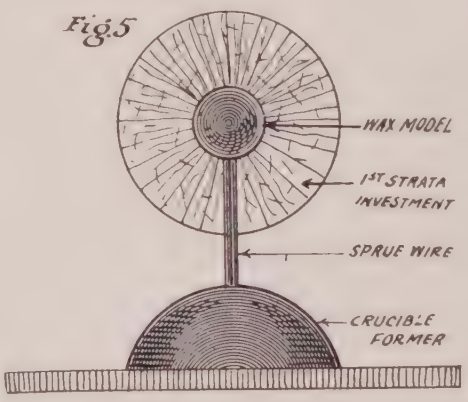
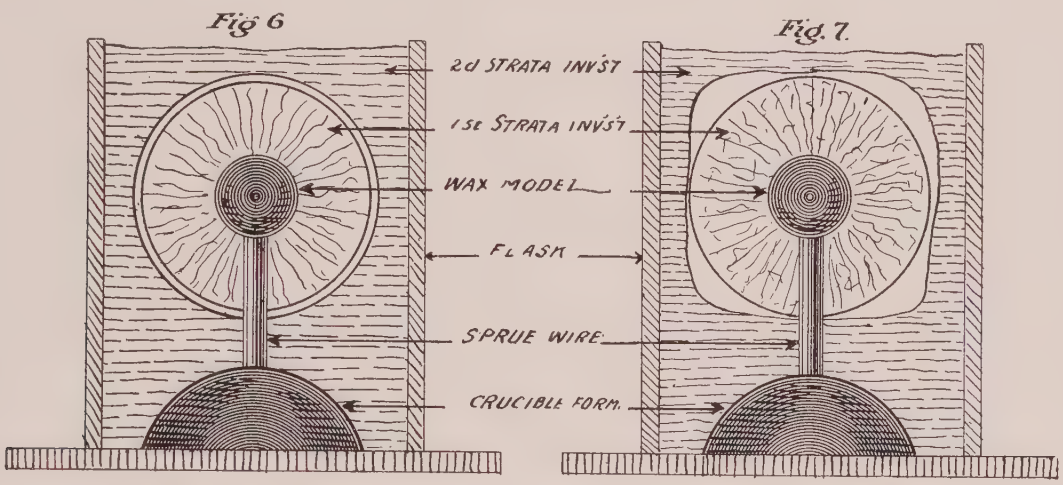


Fig. 5



ference remains unchanged. For the simultaneous increase of the outer and inner dimension of the respective circumferences, without taking into consideration the lateral expansion of the ring, would form a ring the inner circumference of which would measure 36 6-24 with a resultant diameter of 12 2-24 (Fig. 3). But the lateral dimensions of the ring are increased by expansion to the extent of 1-24 inch in each direction from the mean line of lateral expansion (see Fig. 3 and note dotted lines) thereby increasing the lateral dimension of the ring toward the center of the

inner circumference, thus decreasing the dimension of the diameter 1-24 inch at any and every point on the inner circumference of the ring, or 12 2-24—2-24 = 12 in., the 2-24 decrease in the dimension of the diameter due to lateral expansion, offsetting the 2-24 inch gained by the 6-24 inch increase of the circumference. Therefore, the diameter of the inner circumference will measure 12 in., being identical to the measurement of the diameter before expansion occurred. Thus, when the lateral measurement (B. C., Fig. 1) of an iron ring equals the diameter of the inner circumference of the ring (Fig. 1 D. E.) should any expansion or contraction occur, the dimension of the diameter of the inner circumference remains unaltered. Let Fig. 4 represent a ring, the circumferential dimensions of which are identical to Fig. 2, but with the inner circumference eccentric to the outer circumference to the extent as shown in diagram 4. The lateral dimensions of the ring being no longer uniform, should any expansion occur, it would vary in proportion to the changing lateral dimension. Thus, where the lateral dimension measures 24 in., the expansion would be 2-24 in. in each direction from the mean line of expansion; or an expansion of 2-24 in. toward the center of the inner circumference, which would cause a decrease in its diameter



of 2-24 in. at that point, and where the lateral dimensions measure 12 in. the expansion would cause an increase of 1-24 in. in each direction from the mean line of lateral expansion, with a corresponding decrease of the diameter of the inner circumference, at that point. Therefore, the lateral expansion would be of an unequal and varying degree throughout the ring, registering the same varying degrees of inequality upon the inner circumference of the ring. Hence, the inner circumference would no longer maintain the lines of a perfect circle, and the ring would be described as having become warped and the inner circumference distorted.

Now these same laws which govern the expansion of an iron ring, are also applicable to contractions, and also to any substance capable of exercising the property of expansion or contraction. For instance, investment material would be included, it having a tendency to shrink under the application of terrific heat. Suppose we desire to cast a perfect ball; if the wax model was surrounded by an investment of equal consistency, held by a flask in the form of a globe (Fig. 2 could be applied as cross section), and the thickness of the investment equaled the diameter of the wax model, should expansion or shrinkage occur, the dimensions of the mold would remain unchanged. Again, suppose we desire to cast a perfect ball, but the model is placed eccentric to the external surface of the investment (to which Fig. 4 could be applied as a cross section) so that the investment would be of unequal and varying thickness,

then should any expansion or contraction occur, it would be unequal in proportion; as the lateral dimensions are unequal and the effect would be registered on the walls, angles and convolutions of the mold, and the investment would be described as warping, and the mold as being distorted. Now again, let us suppose it is desired to cast a perfect ball, but in an ordinary flask used for dental purposes. Now, if the wax model is attached to the sprue wire and mounted on the crucible former, and the model encapsuled by investment of uniform thickness, equal to diameter of the model, (see Fig. 5) and after this has crystallized, place the flask over it, and completely fill it with investment material (Fig. 6). Then should any shrinkage occur during the process of obliterating the model, or fusing the gold in the crucible, it would be incapable of exerting any deleterious effect on the mold. And for this reason—that the continuity between the first and second stratum of investment is broken and should any shrinkage in the second stratum of investment occur—it being of unequal thickness—the effect of the shrinkage on the mass would be unequal; but the continuity between the first and second stratum being broken, the second stratum would draw away from the first stratum causing no distortion to it (the first or inside stratum) and should the mass comprising the first stratum subsequently shrink, this mass being of uniform thickness and equal in measurement to the diameter of the model, should any shrinkage occur the form of the mold would practically be unaltered (Fig. 7). Hence, during the process of investing a model for the purpose of making a matrix or mold for the casting of gold or any metal under pressure, if the model is encapsuled by a stratum of investment of uniform thickness and equal to the thickness of the model, and be allowed to crystallize, and then this surrounded by the flask and enveloped by a second stratum of investment, it is, for all practical purposes, a geometrical impossibility to distort the mold, should shrinkage of the investment occur. The operator can exercise his ingenuity to an unlimited degree, in investing to the best advantage, models taken from compound approximal cavities including occlusal fissure cavities and copings, so that only an infinitesimal degree of distortion can possibly occur, should the investment shrink or even check.

METHOD OF RESTORING BICUSPID ROOTS TO USEFULNESS

By Auber Peebles, D.D.S., Wilmington, Ohio

There are roots of superior bicuspids sacrificed many times, when a little time and careful effort would make good foundations for the support of strong and serviceable crowns.

In this case decay has extended to such a distance that separation at the bifurcation has taken place. These roots, which are so often extracted, are disinfected, filled and so shaped, that small gold caps may be made to fit each one accurately; and in each cap an iridio-platinum pin is soldered as for a Richmond crown. These caps with pins attached are removed in impression and mounted on model of investing material so as to be able to solder over ends, an oval piece of platinum plate about 28 or 30 gauge: then you have the foundation for a crown.

The remainder of crown is made by adjusting a facing of suitable size and color to correspond with the other teeth, and after backing it with 40 gauge 24k. gold, wax up an inner cusp to properly occlude with lower teeth, and invest in casting ring. After casting with 18 or 20k. gold direct to backing, polish and you have a very strong and very serviceable crown instead of a bridge, which would have been necessary had roots been extracted.

A THEORETIC CONSIDERATION OF THE EXPANSION AND CONTRACTION OF GOLD WHEN CAST UNDER PRESSURE

By C. J. Clark, D.D.S., Chicago, Ill.

One of the perplexing questions that has confronted the dental profession, and been the subject of controversy and discussion since the process of casting metal under pressure has been practiced, is the question of shrinkage and expansion. Of all the literature I have read pertaining to this intricate subject I have, so far, failed to find anything that gave a correct exposition of this question, or depicted a true scientific portrayal of the metamorphosic phenomena the metal undergoes in its transition from the molten to the solid state.

I have read ably written papers comparing the shrinkage of gold when cast under pressure, to the shrinkage of steel rails. I have perused columns of figures, carefully compiled, showing the degree of expansion and contraction of gold under normal conditions, but this is immaterial and not applicable; on the contrary, it is flagrantly fallacious when applied to gold cast under pressure, while the molten metal is confined within the unyielding embrace of rigid walls.

Of all the mechanical achievements that man can boast, there is not one that is not a modification of some mechanical principle utilized in the unfathomed laboratories of nature. In regard to the art of molding and casting, the same cosmic laws prevail with infallible accuracy, whether the proportions are the seething molten mass of an uncooled planet, or an insignificant globule of gold no larger than a pea. Science teaches that the planets and all the solar system once existed in the form of nebulous or gaseous matter, scattered throughout the boundless oceans of space, whirling and revolving, gradually cooling and growing denser, throwing off portions from what we may term parent bodies, and these cast off portions in turn throwing off other portions from their mass, until this sort of process in time evolved our solar system.

So for countless ages the matter of this earth existed in a molten state, gradually cooling and shrinking until the surface became rigid and the internal molten mass became encapsuled by a crust. As the shrinkage continued, matter was called upon to supply the deficiency, and the crust being solid and rigid and held by the power of cohesion, the power of centrifugal force was greatest at the greatest circumference, and of course the portion of the revolving sphere that offered the least resistance (the poles) succumbed to the demands of the internal shrinkage and were drawn inward; and so we find the earth slightly concave at the poles.

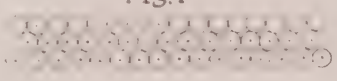
The cooling of the metal in a mold, while not exactly similar, is strikingly analogous to the cooling of a planet or the earth on which we live.

Matter is never at rest; the atoms comprising the molecules revolving around a common center, forming a miniature solar system, are in a constant state of agitation, moving rapidly around in their medium of ether, and confined in their movement to the limited space between their fellows.

Now the outer surface of a mass of matter is the first to be susceptible to any thermal change, the effect being transmitted toward the center, and if this thermal

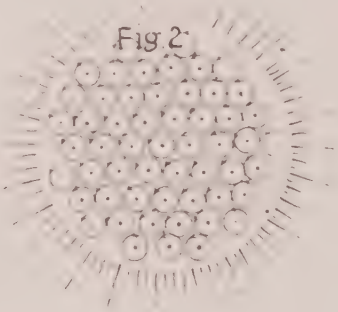
change be of a sufficiently high degree to change the state of the mass from the solid to the liquid, or gaseous, or vice versa, the surface is the first to exhibit these manifestations. (Fig. 1.)

Fig. 1



Let us suppose Fig. 1 to represent a cross section of gold plate, magnified to such an extent that the molecules are visible, and represented by the small circles or spheres. Now, should this plate be subjected to a heat of a sufficient degree, the atoms of the molecules revolve more rapidly than before, become more divergent in their tendency, describing a larger circumference about their common center, the molecules increase in the same proportionate volume, and their mutual power of cohesion diminishes, and this allows the molecules to separate more widely, and permits of a greater latitude in which to exercise their mobility. As the atoms are whirling about their common center the molecules are revolving, and revolving also about each other, generating centrifugal force to such an extent as to overcome the force of gravity, and with a tendency towards projection in every direction; held in restraint only by the still active but greatly diminished power of cohesion. This causes some molecules to be lifted above their fellows and as heat increases the mass begins to assume a globular form (Fig. 2), and presents a panorama of rhythmic harmonious action.

Fig. 2

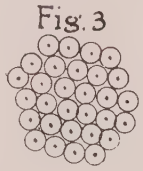


Now if the heat be withdrawn the revolutions of the atoms about their common centers decrease, and as their momentum gradually diminishes the atoms come into closer proximity, the molecules decrease in volume, the power of cohesion increases, the mutual attraction of the molecules becomes more intense, exhibiting more influence than the force of gravitation, and the congealing mass of metal retains more or less of the globular form; the molecules being caught in the act of falling much the same as water is caught and held in the formation of an icicle, see Fig. 3.

The duration of time in which the metal is transformed from a molten to a solid state is exceedingly short, and the fact that the metal retains enough heat to maintain a red color for a time, furnishes no scientific proof that the metal in the mold will shrink, for the metal that remains in the crucible and the metal in the mold encounter conditions in hardening that are diametrically opposed. The metal in the crucible is confined by no walls, and the pressure on it being from without inward has no such effect as on that confined in a mold, for the reason that the hydraulic pressure that the confined gold is subjected to forces the metal from the center outwardly as long as it remains molten, and thus it is pressed against the cooler walls where the crust as described is formed, and which will register a density of 19.45,

against 19.16 of that remaining in the crucible, and there is no inherent force or physical property in the metal itself after being cast under pressure capable of augmenting its density to any further degree, so it is physically impossible for it to

Fig. 3



shrink. Therefore, if in the process of making an inlay or a more extended piece by casting under pressure any distortion occurs, or it is not a fac-simile of the wax model, the discrepancy must be ascribed to some other factor or cause than the shrinking of the gold.

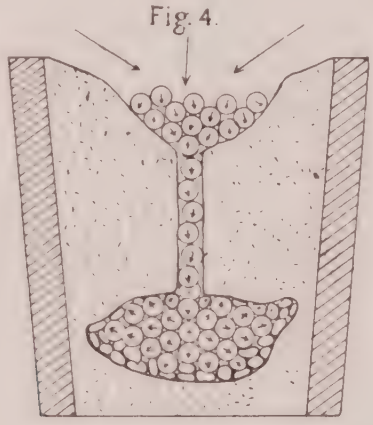
References consulted on Expansion and Contraction of Metals:
(Chicago Public Library.)
Clark, D. K. A Manual of Rules, Tables and Data for Mechanical Engineers. 1878. *K 598.
DuBois, A. J. Elementary Principles of Mechanics. Vol. 2. 1894. K 4982,2.
Dana, E. S. (ed.) American Journal of Science. Vol. 161. 1901. Ser.
Howe, H. M. Metallurgical Laboratory Notes. 1902. K 12780.
Hutton, W. S. Practical Engineer's Hand-Book. 1896. K 5405.
Lineham, W. J. Text-Book of Mechanical Engineering. 1894. K 4958.
Poynting, J. H. and Thomson, J. J. Text-Book of Physics. 1904. K 15930,3.
Rankine, W. J. M. Manual of Civil Engineering. 1891. K 661.
Useful Rules and Tables. 1873. K 665.
Thurston, R. H. Brasses, Bronzes and Other Alloys. 1900. K 5502,3.
Watson, W. Text-Book of Physics. 1905. K 15933.

If this globule of gold were measured for its specific gravity it would be found that it developed, by the mutual attraction of its molecules (cohesion) a density that registers a relative specific gravity of 19.16. Thus, if gold, heated so as to assume the liquid state, be allowed to congeal uninfluenced by any interfering conditions, the only factors entering into the phenomena being mass, cohesion, heat, molecular mobility, volume and gravitation, it is a physical impossibility for the metal to develop, by virtue of its cohesive force, a density that registers a relative specific gravity above 19.16. In the casting of metal under pressure, additional factors enter, and must be taken into consideration; they are hydraulic pressure and welding, the latter being induced by the force of hydraulic pressure.

If a mold has been prepared in the usual procedure for a cast under pressure, and is in a condition for the reception of the molten metal, a button of gold fused in the crucible manifests the same physical phenomena previously described and represented by Fig. 2. The atoms will revolve around their common center more rapidly than at a lower temperature, and the molecules will revolve around each other in like manner and the metal is gradually transformed from the solid to the molten or liquid state. If force now be suddenly applied to the liquid mass in the crucible a portion of it will be forced by displacement into the mold, and if the pressure be maintained for a time it will be transmitted from molecule to molecule simultaneously in every conceivable direction, the hydraulic force pressing the molecules to all surfaces and angles of the mold. As the molecules at the surface of the mass come in sudden contact with the walls of the mold, their movements are abruptly checked, the atoms of the molecules are forced to closer proximity, the molecules decrease in volume and have less latitude in which to exercise their

mobility, which instantly induces congealation; and as they are held firmly against the walls of the mold, gaps and crevices occur, which are, however, filled by the pressure behind, and with inconceivable rapidity, with new recruits, frenzied and

Fig. 4.



heat-maddened, where they meet the same fate as their fellows, crushed and jammed against each other and the walls of the mold until in congealing a rigid wall or capsule lines every surface and angle of the mold. (See Fig. 4.)

This goes on in the same way until the surface crust thickens to the center, all following the same regular order of things, but with no loss of appreciable time, in a small mass of gold as might be inferred from the deliberate description. This metal will be found to be of higher specific gravity than when it is allowed to cool under ordinary conditions. A pressure of 12 pounds induced by expanding gas will bring about a density or specific gravity of 19.45.

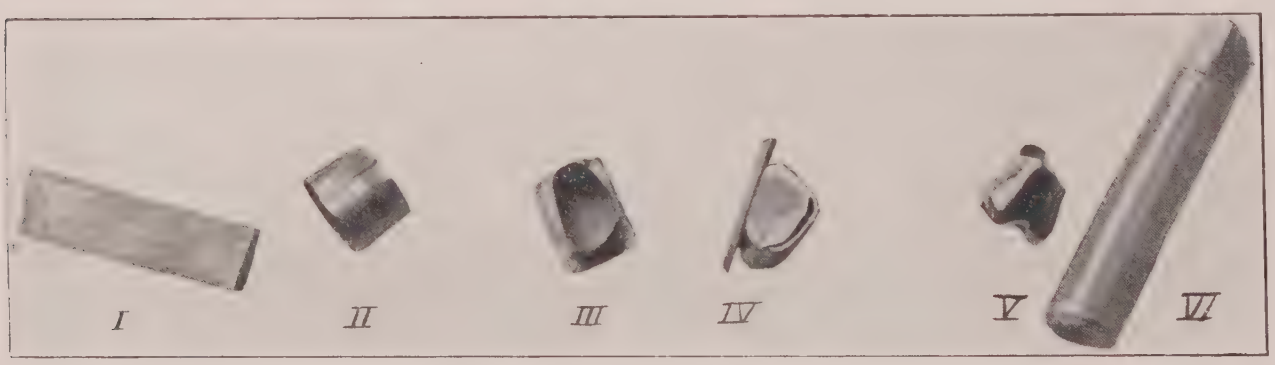
TELESCOPIC CROWN FOR BRIDGE WORK

By E. L. Kanaga, D.D.S., Philadelphia, Pa.

No. 1. A piece of metal for the band is cut from 30-gauge coin gold, the occlusal end being 1-32 of an inch smaller than the gingival.

No. 2. Showing the band joined sweated.

No. 3. The floor sweated to the band.



No. 4. The core is formed by holding the inner cap in a paper form and pouring fusible metal into it.

No. 5. The outer cap is made by driving the inner cap, now mounted on the core, into it.

No. 6. Shows method of obtaining contour.

THE EXTENT TO WHICH THE CASTING PROCESS MAY BE ADVANTAGEOUSLY APPLIED TO CROWN AND BRIDGEWORK

By Hart J. Goslee, B.S., D.D.S., Chicago

The full extent to which the application of the casting process may have revolutionized the practice of dentistry is, of course, difficult to determine, but it is safe, I think, to say that its influence has been, and is now being, felt to a greater or less extent by even the most obscure dentists in the most remote districts.

Whether all who are now doing casting in some form or other will care to acknowledge it, or whether they will concede its revolutionary influence, and the marked advancement made possible by its application, or not, may be a question; but that at least a very large percentage of dentists are doing casting, and that they are doing better work, and doing it with infinitely greater comfort to their patients and with the expenditure of less nervous energy on their own part than they formerly did, there can be no question.

That some are much more enthusiastic over its possibilities than others, and that some are getting much better results than others is also unquestionable, and it is as interesting as it is true.

However, this is but a natural sequence and should be expected in any field of effort in which former accepted practices and methods of long standing become so completely revolutionized and supplanted, if you please, in so short a period of time; where the pedestals upon which the cherished reputations of so many prominent practitioners were made to crumble and totter, almost in a day; where old and young must begin anew and alike, and where the application of this newer practice and its practicability must necessarily be tinctured with a saturated solution of personal equation.

From the beginning, however, it has been interesting to note that those who were early to grasp the possibilities of casting and, hence, who have been and are still doing the most of it, are the most enthusiastic over it, and, therefore, does it not naturally follow, by the same rule of thumbs, that those who were first to grasp and accept its wonderful possibilities, who have been and are still doing the most of it, and who are most enthusiastic over it, are also the ones who are obtaining the best results?

While it may be true that the proportion of those who ever attain to the very highest achievements in any mechanical pursuit is not a large one, still I am of the very firm belief that the casting process has afforded an opportunity for raising the standard, and increasing the percentage of uniformly good results; and, in the light of our present achievements, that this standard will become higher and higher in proportion as we recognize our own personal limitations, and realize the full scope of its possibilities.

Those, who by a process of self-analysis, may thus recognize their own limitations will not expect a mechanical process, or a machine of any make or kind, to adjust and adapt itself to the varying and intricate demands of an exacting

line of work, unless the process is followed, or the machine operated, with an average degree of human intelligence, but those who fail to recognize this are surely destined to meet with failure.

Thus it is more than probable that many may have failed in attaining to the heights of even average success simply because they expected too much of the process involved, and exacted too little of themselves, but those in this class never become enthusiasts, and those who never become enthusiasts rarely become experts in any line.

Enthusiasm, expertness and all that goes with, to make for, and insure, success in the application of any mechanical process can, after all, come only from the "man behind the gun," and hence the operator who aspires to such must be willing to acknowledge this fact and contribute his share; and in this instance his share is in the form of ammunition, and the ammunition now needed most of all is correct and accurate technique.

While the factor of personal equation will necessarily demand a more or less different technique for each and every operator, yet the most scrupulous attention to details, and the utmost of accuracy is necessary in each instance, and as such a technique is to be acquired only at the expense of time, thought and energy, it is scarcely purchasable, nor may it result from delegating important parts of the work to laboratories, or to inexperienced or unskilled assistants, as is a common but bad practice.

When the average operator realizes these essentials to success, then the average operator may reasonably hope to rise above the average and achieve success in the application of the casting process, and as he appreciates them will he also find the field of usefulness broaden and the possibilities become more and more unlimited.

If there were no field to which the casting process may be applied other than the one which embraces the filling of teeth, however, let me ask you what a long-felt want would it still afford; what a broad field of usefulness would it occupy; what a priceless advancement would it mark in the preservation and restoration of the teeth, since it is now generally conceded that the inlay affords a better, quicker, less painful and probably, on the average, more permanent character of operation?

Granting all of this to be true, however, the limitations of this process have by no means yet been reached. Indeed, it seems that they are still only in their infancy, and that the field of usefulness as applied to all other phases of practical dentistry is as broad and far-reaching as is the degree and character of success already insured in the filling of teeth.

While this is undoubtedly true, to a greater or less extent, as applied to the whole field of dental prosthesis, it is particularly true as applied especially to the subject which it is my purpose to discuss at this time—that of crown and bridge work.

But a few—a very few—years ago this line of our work, which many of us are now pleased to designate and dignify as a "specialty," was but an indeterminable collection or mass of empirical details. Almost every dentist had his own ideas, and his own methods, and each differed from the other to such an extent as to confuse the teacher, and bewilder the beginner, in every respect and direction except one—the display of gold.

For many years patients wearing crown or bridge work, however limited or

extensive in character, were involuntary advertising mediums for dental jewelers; were forced to display shocking evidences of a handicraft which, while in some instances useful, perhaps, were usually far short of art, and always more or less repulsive.

These evidences, I am sorry to say, may still be observed, but fortunately not to the same extent. As a profession, we are beginning to strive for higher ideals in the art side of our work, and in this respect we are aided materially by the demands of an ever-increasing degree of culture on the part of our patients.

Since porcelain has always been and is still the one substance which most closely simulates nature, and therefore best meets the requirements, this fact, together with these combined ambitions on the one part, and demands on the other, must lead one to conclude that more porcelain and less gold must be used in an effort to satisfy each.

While this was recognized many years ago, still the inherent element of structural weakness so characteristic of porcelain, and so often learned from sad experiences, together with the knowledge that cosmetics was but one requirement, and that in the construction of all forms of crowns and bridges the actual mechanical requirements of strength and accuracy of adaptation must necessarily receive first consideration, it is no great wonder that cosmetics was accordingly sacrificed.

If it were not, and if it is not, possible to obtain both of these requirements at one and the same time, then cosmetics should be placed second to, or sacrificed for the purely mechanical, but the possibilities of casting offer opportunity for obtaining all of the combined requirements to the very highest degree, and hence its application may be made to practically revolutionize all of our former methods.

This is possible because the casting process, skilfully utilized, insures, first, accuracy of adaptation, and, second, a maximum of strength with a minimum of gold; and in the proportion as the amount of gold necessary to insure strength may be decreased, the amount of porcelain may be increased. Thus, if our work be properly constructed, less gold and more porcelain may be safely and successfully used, and the suggestions which I have to offer you along these lines are based entirely upon the theme of more porcelain and less gold with equal and adequate strength.

Such manifestly desirable advantages are now to be obtained by means of a skilful application of the casting process, combined with a more general use of all-porcelain teeth instead of the ordinary thin facings.

You will probably agree with me that this type of tooth is preferable for single artificial crowns, because it affords better form, better color and greater strength than it is possible to obtain from the use of facings. Also that an all-porcelain tooth is better for bridge work because the presence of an occlusal surface of porcelain instead of gold, on any or all of the posterior teeth, is advantageous not only for cosmetic and hygienic reasons but for actual masticatory purposes as well.

These advantages are so evident that the more esthetic operator has been forced to look and hope for some form of tooth, and some method of application which would eliminate the inherent weakness of thin facings, and the objectionable features incident to their use.

To overcome the shortcomings of the so-called "Richmond" crown, and of the ordinary bicuspid and molar dummy with porcelain facing and gold cusps, the advantages of some form of interchangeable or replaceable all-porcelain tooth, more closely simulating the form and color of the natural teeth, were early recog-

nized. As a result of this recognition, many types have been introduced, but until very recently most of them have been of the thin facing variety, and applicable to the anterior teeth only.

While the all-porcelain teeth, such as the Davis, Logan and Justi crowns, have always been recognized as being the nearest approach to an ideal substitute for the natural teeth, yet they were not originally designed to meet the present requirements of crown and bridge work, and hence their use has been confined to that class of cases where more or less temporary results were all that was expected or demanded.

If the esthetic and hygienic advantages possessed by this type of tooth, however, could be combined with those of exact adaptation, and uniform and adequate strength, and if to these might be added the further advantages of being cemented to the structure instead of soldered, and of being replaceable and more or less interchangeable, it is evident that our efforts would be a nearer approach to the ideal.

In my opinion, which has been often expressed, the attachment of porcelain teeth or even facings to the metal structure by means of soldering, or of direct casting, is wrong. It is a wrong principle because the porcelain is subjected to a degree of heat which must endanger its structural integrity and influence the preservation of its color; because the tooth or facing is thus attached in a stiff and rigid manner, and, being friable, is more likely to fracture under the stress of mastication; and because, in the event of accident, no favorable opportunity for repair or replacement is usually afforded.

I think you will also agree with me, therefore, that the elimination of these objectionable features must necessarily constitute an improvement, and that such an improvement is to be obtained by the use of replaceable teeth attached to the supporting metal structure only by means of cementation.

An experience of many years has proven that this means of attachment is reliable in proportion as the adaptation of the metal to the porcelain may be close and accurate, or, in other words, in proportion as the porcelain may be "boxed up," protected and supported. It is stronger when so attached because it is not subjected to any degree of heat, and is not held so rigidly, due to the cushion-like effect afforded by cement; and because, not being held so rigidly, it is less likely to become fractured. Furthermore, the color is never changed; those dark blue marginal outlines due to the penetration of saliva between backing and facing are absent, and opportunity and facility for replacement in the event of accident always presents.

As I have previously stated, these possibilities and advantages are to be adequately obtained only in some form or type of tooth which presents as much porcelain as possible, which porcelain is not weakened by the presence of metal pins nor by the provisions for retention, and which, therefore, possesses a maximum of strength; which is of natural form, more or less universally applicable, and which will need but a minimum of grinding for effecting the desired and required adaptation.

This latter feature, as applied to the retentive surface, is essential, because in proportion as a given form of porcelain tooth will require but little or no grinding upon this surface in effecting its adaptation to the requirements of the individual case, may it be expected to be replaceable or interchangeable.

These combined advantages, I believe, are to be obtained in a form of tooth

suggested by your essayist, and now known as the "Goslee Interchangeable Crown and Bridge Tooth," (Fig. 1) to which I am pleased to call your attention.

It will be observed that these teeth as now made are of natural form; that they possess the splendid strength and color characteristic of the Consolidated tooth bodies; that they are adapted to single crown work where any form of metal base is used, as well as to intermediate teeth, or "dummies" for bridge work; that they afford a minimum display of gold and require but a minimum amount of grinding, and that with a sufficiently large variety of molds they should be almost universally applicable; also, that they are strongest where the greatest strength is required; and that they offer ample opportunity for secure retention to the supporting base or structure.

A further advantage made possible by the use of replaceable or interchangeable teeth, which applies particularly to especially difficult cases, is to be obtained by making duplicates, and while it is true that any form of interchangeable tooth

Figure 1

is far less likely to become broken from the stress of mastication, yet the making of duplicates coincidentally with the initial construction requires but little time, is always a source of inestimable protection to the particular patient, and affords unlimited relief and satisfaction to the dentist. It is, therefore, a safeguard which might be observed often and profitably by everyone whose necessarily small fees do not render it prohibitive.

In all instances, however, whether duplicates are made or not, the color number and mold number of each tooth used in every case should be recorded on the card or ledger sheet, and thus made a permanent part of the record. Because of these advantages and for these various reasons I firmly believe that only some form of interchangeable tooth should ever be used in single crowns, or "fixed" bridge work, of any type, if the best results and highest possibilities are to be attained in our efforts.

In addition to such desirable improvements as may be achieved by the use of teeth of this character, the introduction and application of the casting process has placed this field of our effort upon a more systematic and practical basis, as an evidence of which permit me to call your attention to the methods which I am now generally employing, almost to the complete exclusion of all other and former procedures.

SINGLE CROWNS

For the ten or twelve anterior teeth, or all teeth within the range of vision, where porcelain is demanded, the all-porcelain replaceable or interchangeable

crown, with *cast base*, and with or without a band, as the requirements may indicate, is used in a very large percentage of cases. It is undoubtedly the strongest, most artistic, and most universally applicable type of substitute for the natural tooth, and in all respects is second only to a skilfully adapted "jacket" crown. Indeed, for the average dentist it is better, more quickly and easily made, and, moreover, it possesses an advantage over the latter in that immediate replacement, in the event of a mishap, is possible.

PORCELAIN CROWNS WITH CAST BASE

In the construction of this type of crown much difficulty has heretofore been encountered in molding the wax to a close adaptation to both the root-end, particularly at the periphery, and the base of the crown, and in holding the dowel or dowels in the proper position to insure correct alignment.

These essential features have usually been so uncertain, and in some instances so difficult and so unsatisfactory, as to cause me to work out and suggest a technique which eliminates such uncertainty, which insures accuracy, which is applicable alike to all cases, whether a band is required or not, which relieves the patient of any discomfiture whatever, and which has proven the most satisfactory method of crown construction I have ever followed.

In the various methods now generally used and advocated, good, accurate, reliable results are difficult to obtain, because the very plasticity of wax of any kind makes it possess a tendency to spread when subjected to the pressure necessary to mold it to a close adaptation. This tendency is best and most easily overcome by first adapting 38 gauge pure gold to the root-end, which may be done either by swaging or burnishing, and then adjusting the dowel, tacking it to the base with solder, and subsequently molding the wax to both base and tooth and casting directly to this disc of pure gold. If carefully done, the surface thus obtained will always be a closer fit to the root-end than can be obtained from the molding of wax alone with any investment material now procurable, and will require no finishing whatever after casting.

Such a procedure also reduces to a minimum the possibility of any change of form which may result from the warpage or shrinkage of the gold or alloy used in casting, but to obtain the best results necessarily involves the impression and die method, as illustrated in Fig. 2, and explained in detail in the Dental Cosmos, August, 1911.

The entire process requires but little time, is simple, insures a more or less perfectly adapted base, and one which is obtained without the slightest discomfiture to the patient, which is not possible when *burnishing* directly to the root-end is attempted. For single crowns a slight lingual lip or band is usually all that will be required. This strengthens the attachment between crown and root, and precludes the possibility of subsequent fracture of the root—for which purposes a band is usually used, but in all cases where the crown is to be used as a bridge abutment a full band should remain.

The construction of a crown by this method usually involves but three short sittings, and the best results are to be obtained by doing all the work directly in the mouth. At the first sitting the root is prepared, the root impression taken the mold number and color selected, and a temporary crown mounted. This latter feature is desirable as a means of packing the soft tissues away to afford and insure a free exposure of the root-end at the next sitting, as well as to relieve the

patient of the temporary embarrassment. The amalgam die having been made and the pure gold disc swaged and tooth selected, in the meantime, at the second sitting the cap is fitted to the root, the dowel and tooth adjusted to the require-

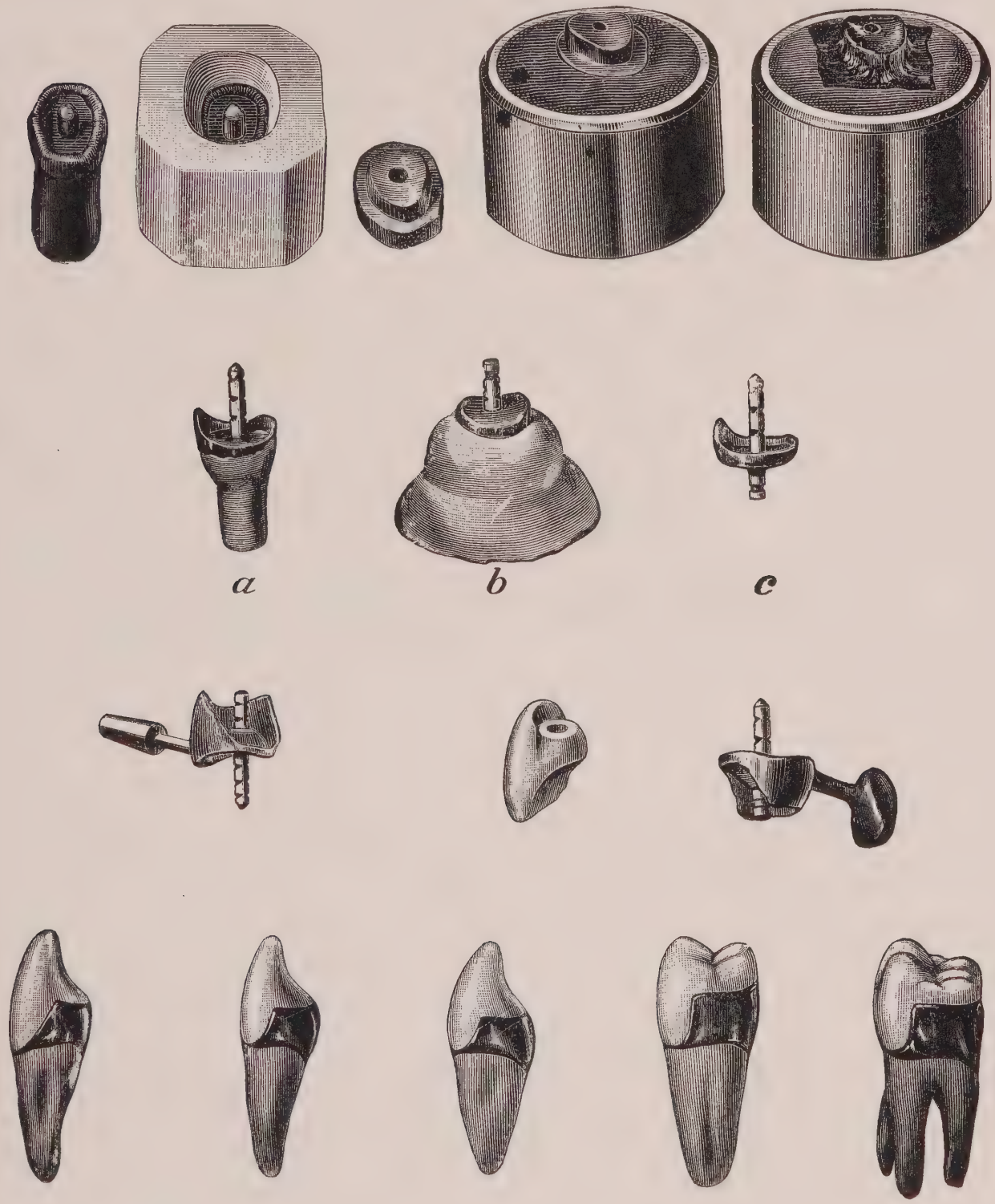


Figure 2

ments, the dowel then soldered to the cap, and the relation between the tooth and cap secured with casting wax. The crown is then cast, the tooth cemented to place and finished, and the final mounting is made at the third sitting.

GOLD CROWNS

For second and third molars—and even first molars, when the presence of gold is not objectionable—the cast gold crown affords results far in advance of anything heretofore obtained. In the construction of gold crowns by the casting process, however, the fit or peripheral adaptation is, because of the spreading tendency of the wax, *always best obtained* by previously fitting some form of band to the root and then casting directly to it.

Technique—Whenever it is desirable to exaggerate the contour, a narrow band of platinum or 22 karat gold, of about 30 or 32 gauge, should first be made to fit snugly around the entire periphery and then trimmed to evenly approximate the end of the root, after which all of the contouring may be done in wax, which can be best done, perhaps, on a model.

When an exaggerated contour is not required, however, and one seldom is, the band may be made of 28 gauge, 22 karat gold, and fitted and contoured in the usual manner. When in position on the root, casting wax is then molded to the end of the root inside of the band, and this procedure followed by an imprint in the wax of the opposing teeth in all the movements of mastication.

After the band has been removed, its interior should be filled at once with casting investment material and the occlusal surface properly carved, after which it may be invested and cast, using for the casting the same grade of gold of which

Figure 3

the band was made (Fig. 3). If the band is thoroughly clean before investing, and the gold to be cast is of good quality and highly fused before casting, a good physical union will usually result, but if it does not, a small bit of 22 karat solder will insure the same.

These two general types of crowns will meet the requirements of single crown work in a very large majority of cases, and the results by either method are far more accurate than by any of our former methods.

FIXED BRIDGE WORK

In fixed bridge work, which constitutes an assemblage of attachments and intermediate dummies, our work may also be simplified, because three general types of attachments and three general types of dummies will be found to meet the requirements in an exceedingly large percentage of cases.

Attachments—The methods of obtaining attachment to the supporting teeth or roots embrace the porcelain replaceable crown with dowel and cast base, the construction of which has just been referred to, as applied to the roots of anterior teeth, or when it is impossible or inadvisable to preserve the natural crown; the inlay, when the attachment is to be made to the crown of a natural tooth, which is good practice when the remaining natural crown is sufficiently strong, and the gold crown for the molar teeth when the use of an inlay is for any reason not indicated,

As previously emphasized, wherever a dowel crown is to serve as an attachment for bridge work, a narrow band should always be used. In my opinion, this is absolutely essential, because of the additional strain to which the root is to be subjected, and as a means of insuring permanency and precluding fracture.

When an inlay is to serve as an attachment the cavity preparation is, of course, exceedingly important, and some form of post or posts should always be used to insure stability and as a provision against the inlay becoming loosened by the strain and possible torsion to which it is to be subjected.

The general applicability of the inlay as an attachment for bridge work has been a subject of considerable discussion ever since casting became an accepted practice. That it will serve the purpose as well as, and in some respects even better than, a full crown there can be no doubt, providing its adaptation and stability are insured.

The former depends first, upon adequate and proper cavity preparation, and then careful technique in making the inlay; and the latter depends upon the use of a proper alloy in casting, and upon pins or posts of some form, for the reasons mentioned.

Figure 4

Wherever the walls of the supporting tooth are sufficiently strong to insure permanency; whenever a suitable cavity may be properly prepared, the inlay, well-seated and securely anchored, and made of a hard alloy, such as five per cent. platinum in pure gold, coin gold, or 22-karat gold, I am of the impression that such an attachment is often better than a full crown because of the absence of any possibility of gingival irritation, such as is so often present where the latter is used.

The cavity preparation for such inlays does not differ essentially from that for a simple filling, excepting that its buccal, lingual and cervical margins must be so extended as to carry the margin between tooth and filling beyond any actual contact of the artificial tooth to be supported by it, in order that each and all of these margins may be exposed, for hygienic reasons. (See Fig. 6)

"Dummies"—As dummies for fixed bridge work, three general types will answer the requirements in all cases.

The all-porcelain replaceable crown and bridge tooth with cast backing is adapted to all positions in the arch where the conditions of absorption and occlusion will permit their use, and is undoubtedly the ideal form of artificial substitute. Backings for these teeth should usually be cast separately, though they may be made in sections involving the number of dummies between the attachments, which should never exceed three, or possibly four. Better form, cleaned inter-

proximal spaces, and less display of gold, however, are obtained by making each backing separately.

As a means of preserving the proper relation of the short sustaining post which holds the tooth to the backing, and of insuring a smoother surface adaptation of the backing to the porcelain than the ordinary casting investment materials afford, in using this type of "dummy" a thin backing of about 38 gauge, pure gold should be previously swaged to the tooth, as indicated in Fig. 4, and the post soldered to it. It is then always necessary to allow as much surplus end of post as possible to extend beyond, in order to insure strength in the final attachment of this essential part to the completed backing.

Figure 5

Casting wax may then be molded to the required form, and the casting made directly upon and against the thin gold backing, by which method any distortion or possible misfit due to shrinkage or warpage is overcome, and the most finished, accurate, and reliable results are insured.

In the use of this type of tooth in all cases in the upper arch where complete absorption has already taken place, the most sanitary form of structure is usually to be obtained by molding the wax so as to restore or approximately follow the lingual form of the tooth, but tapering down to a narrow saddle at the point of contact with the soft tissue. As a rule, and contrary to the opinions of some, however, wherever the adaptation is good, such a type of construction will be found to be far more sanitary than the usual recesses, shelves, and pockets, so common in the ordinary methods.

In the formation of this type of saddle, the desired results may be best obtained by first burnishing the same thickness of pure gold to the model, between the finished abutments in position thereon, and then trimming it to conform to

the size of the necks of the teeth to be supported by it. The general form of the structure may then be made by filling in between this saddle and the backings with wax, after which the piece may be invested and cast. Or in instances where this space is exceedingly small it may be filled with solder.

In this more or less typical fixture (Fig. 5), it will be observed that practically no gold is displayed anterior to the second molar, and yet that a maximum of strength presents throughout.

In cases where complete absorption has not occurred, a saddle is, of course, contraindicated, but in these cases the neck of the porcelain tooth should accurately fit and should bear firmly upon the soft tissue, and the lingual surface of the backing should then be so formed as to be as nearly convex or self-cleansing as possible.

For those cases in the anterior region where abnormalities of occlusion or elongation of the opposing natural teeth demand a thin facing, the ordinary type of long pin facing may be used. In its use, however, the best results are to be obtained by previously backing it up with thin pure gold, adding wax to this to the desired form, removing the facing and casting. The pins may then be threaded and, when the backings have been assembled with solder, the facings may be cemented to position, thus obtaining all of the previously mentioned advantages of cementation, combined with better form and more uniform strength.

In addition to these, for those cases particularly in the lower arch, and in exceedingly "close-bites," where cosmetics is not a factor, or where the extent of absorption or the elongation of opposing teeth precludes the use of porcelain in any form, the all-gold, cast dummy may be used. Such dummies may be made to conform to the requirements of occlusion, adaptation to gum—if such is required —and contact with the attachments, in wax, and then invested and cast in one piece. This type of "dummy" is useful in supplying the lower second bicuspids and first and second molars and may include only the occlusal surface, thus forming the so-called "self-cleansing" type of bridge, or the entire tooth with or without a saddle, as the requirements may be. The former type of construction is indicated only where there is an excessive degree of absorption, which will permit of sufficient space between the gum and occlusal surface to insure self-cleansing properties, and wherever this space is not great enough to be *easily kept clean*, direct contact with the gum will afford a more hygienic result. In other words, there should be plenty of space, or none at all. A typical case of this kind showing the use of all-porcelain dummies in connection with inlays is illustrated in another model.

With these, the problem of attachments and of intermediate dummies for almost universal application is simplified and systematized.

The remaining feature incident to the construction of all forms of fixed bridge work involves only the proper assemblage of the various parts. While some are casting all attachments and backings with an alloy of five per cent. of platinum in pure gold, and subsequently assembling them with pure gold, thus using no solder whatever, still a good grade of 22-karat gold or coin gold may be used with equally good results. When either of the latter is used, the final assemblage may be effected with 22-karat solder, and providing there is absolute contact between all of the parts to be united, the procedure is thus somewhat facilitated, and the results are uniformly good.

REMOVABLE BRIDGE WORK

The same general ideas are also applicable to the construction of removable fixtures.

For this class of work, also, three general types of anchorage to the supporting teeth or roots will be found to adequately meet the requirements of the average case. These embrace clasps, the telescoping tube and split post, and the various forms of manufactured attachments.

Figure 6–A

Wide clasps encompassing three angles of the tooth, provided with an occlusal rest, not cast, but made of heavy rolled clasp-metal alloy, probably afford the very best means of obtaining anchorage to the natural or artificial crowns of bicuspids and molars.

That clasps should not be cast is especially emphasized, because the molecular rearrangement resulting from casting most of our present alloys destroys to a greater or less extent the very qualities of strength and resilience demanded of them, and which undoubtedly obtain best in a rolled or drawn metal or alloy.

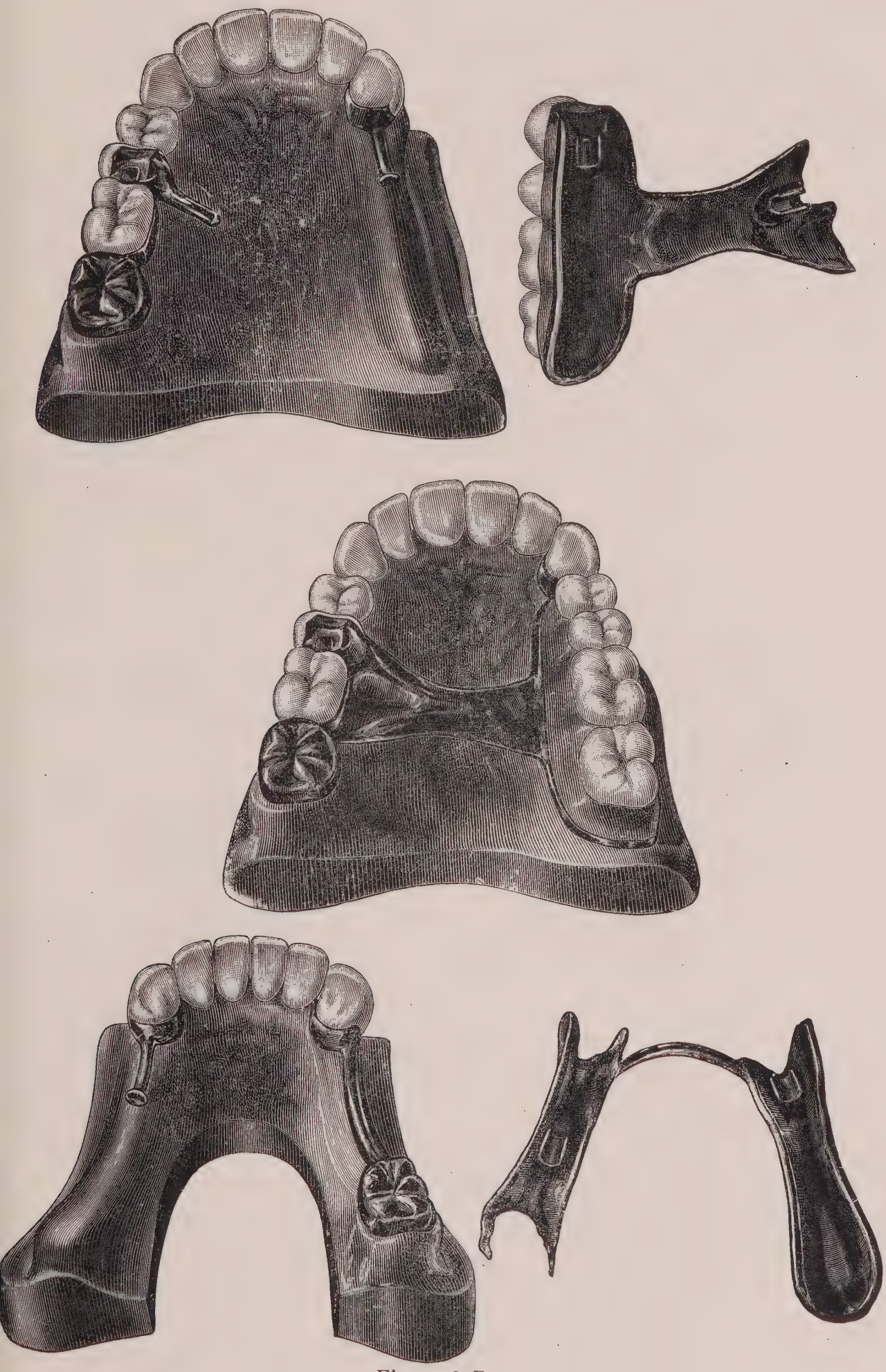


Figure 6–B

In all forms of removable bridge work or partial dentures, where clasps are used, however, some form of occlusal rest is necessary as a means of providing against subsequent settlement of the case. If this precaution is not observed, complete loss of occlusion and usefulness will soon follow.

The telescoping tube and split-post attachment is also useful when confined to the roots of the six anterior teeth.

The Roach, Morgan, Gilmore and other types of manufactured attachments will also be found valuable when used in connection with either porcelain or gold crowns or inlays on the cuspids and bicuspids.

When the type or types of attachment thought to be best indicated have been selected, adapted, and completed, the casting process then offers splendid opportunity and great possibilities for the subsequent formation of the body of the fixture, and in this connection I believe that the successful casting of large pieces is only a question of the development of proper technique.

In the construction of cast bases, if a good model of a high grade investment material is obtained, and if the wax base is carefully formed, made sufficiently thin and properly stiffened, the process offers the same assurance of accuracy of adaptation and of strength as previously indicated, and the possibilities are equally unlimited. For all forms and sizes of saddles, or bases, coin gold seems to be especially adapted to cast work, and to afford all of the integral strength ordinarily demanded.

In the presentation of much of this technique, quotations from former papers have been necessary, to a greater or less extent, but the fact that repetition is made to serve in preference to changes and alterations only proves that I am still courageous in my previous convictions.

As a final suggestion, permit me to again impress upon you the advantages of simplifying and systematizing your methods, and of casting; the necessity for careful technique and the unlimited possibilities resulting therefrom.

CAVITY PREPARATION FOR CAST GOLD INLAYS

By Thomas P. Hinman, D.D.S., Atlanta, Ga.

In reading the literature on the subject of cavity preparation for cast gold inlays, I find that very little attention seems to have been paid to this most important subject. Operators who had been constructing gold inlays by the gold or platinum matrix method previous to the announcement of the Taggart inlay have evidently been using practically the same method of cavity preparation for the Taggart inlay as they have been accustomed to when using the gold or platinum matrix. In making this statement I am judging the mass of our profession by those with whom I have had discussions along this line.

In using the metal matrix all that was necessary to avoid in cavity preparation was undercuts, for it is obvious that if the matrix could be removed from the cavity without distortion, it could be filled with solder and returned to the cavity and would seat as perfectly as before. This, however, I have found, is not true of the inlay cast from a wax impression. The reason for this is that if the sharp angles are left in

Fig. 1

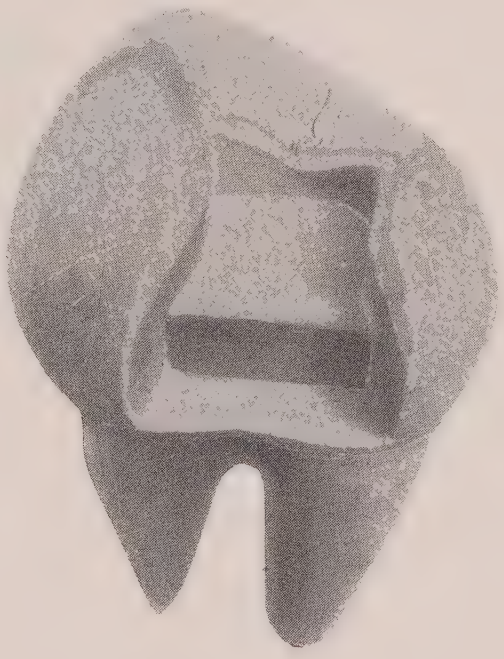


Fig. 2

the cavity they are reproduced in the mold or investment and when the molten metal flows over them it rubs the investment in such a manner as to round these sharp corners, and when the inlay is returned to the cavity it will not properly seat.

I have found that inlays cast for cavities in the proximo-occlusal surfaces of the bicuspid when prepared by the old method will lack to a considerable degree seating at the gingival border. This observation has been made by numerous other operators and has been accounted for to a considerable extent by the theory that gold shrinks on cooling, but my observation has been that the shrinkage of the gold will not entirely account for the misfit of the inlay. Again, the floor of the cavity has been left rough and the inlay will not seat because these same indentations are

not perfectly reproduced in the casting, as the very sharp edges are rubbed off by the molten gold as it flows into the mold.

Figure 1 represents a cavity in the occlusal surface of a lower molar. You will note that all of the angles have been removed from the cavity margins and axial walls and that the floor is perfectly smooth and flat. Note also that the margins are very slightly beveled from within outward, so as to allow a narrow lap of the gold at this point, preventing the pumping out of the cement during mastication. If the cavity was left with sharp angles where the fissures cross and an inlay cast for the cavity, it would not seat or fit, because the sharp angles in the investment would not be reproduced in the inlay for reasons heretofore stated. This would not be true if we had an investment sufficiently hard to withstand the friction of the molten metal.

Fig. 3

Figure 2 represents a cavity in the mesio-occlusal surfaces of the bicuspid. Note that the neck of the retention step has no sharp angles to be knocked off by the molten metal flowing into the mold. Note also that where the step joins the axial wall that the sharp angles have been rounded with a stone. If we use curves instead of angles at these points the inlays cast to fit such cavities will seat perfectly.

Figure 3 represents a compound cavity in a bicuspid correctly prepared. Note the sweeping curves and the absence of acute angles.

IN GENERAL

If cavities are prepared with small carborundum stones instead of burs there is less liability of producing angles and rough floors, and inlays cast to fit cavities thus prepared have smoother surfaces on the side next the dentine.

SHAPING WAX MODEL FOR CAST GOLD INLAYS

By C. E. Abbott, D. D. S.

The following method is of great value in shaping the wax model: "In compound proximal cavities in bicuspids and molars I adjust the medium soft wax to approximate contour and bulk; then I stretch a strip of rubber dam, ½ inch by 2 inches over it and against it, holding the ends taut with the left hand. Pressed against the cavity by the rubber dam, the wax is easily burnished to exact proximal contour, occlusal contact, and smooth surface. I then remove the rubber dam, invest and cast as usual."

THE CEMENT LINE IN INLAYS

By Clarence J. Grieves, D.D.S., Baltimore, Md.

NOTE—The writer respectfully refers all interested to his paper, "Cemented Inlays or Contact Fillings, Which?" read before the Virginia Dental Society, August, 1906, and published in THE DENTAL SUMMARY, which deals with work on the first phase of this subject, and is necessary to an understanding of his position in this article.

The one leading question foremost in the mind of every operator who attempts restoration of destroyed dental tissues, second only to the removal of the destroying agents and the destroyed and the shaping of caval edges, is whether the final cavo-juncture between filling and enamel will be lasting mechanically to meet stress, and to prevent retention centers for recurrent caries and adhesive chemically to prevent leakage by solution, by sealing these edges; so obvious is the importance of the subject, for it is the final equation in the art of operative dentistry, that this paper needs no further introduction. No matter what the method or filling material heretofore employed, its perfect adaptation required cavo-surface contact excluding mouth juices; edge strength to meet occlusal food impact, supporting caval enamel edges; smooth surfaces to prevent re-attachment of gelatinous carious plaques; extension out into the embrasures to prevent the retention of food and be cleansed by the brush of it in mastication practiced with varying results dependent on the material, location of cavity, skill of the operator, immunity of the patient, etc., etc., we find all of these time-honored requirements for a successful contact operation completely reversed by the advent of the method of the cemented inlay filling.

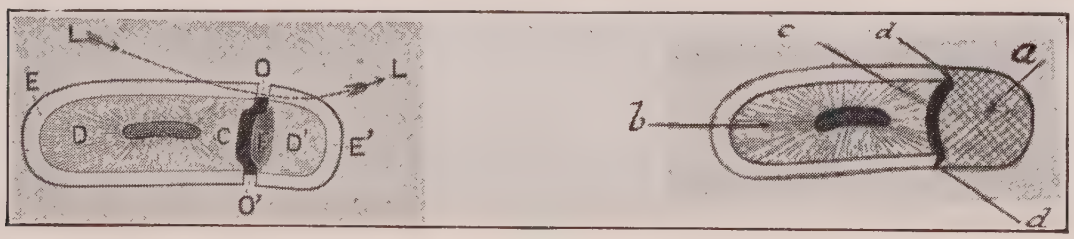


Fig. I Fig. II

Fig. I. From Nyman's "Porcelain Problems," *Cosmos*, 1905, diagrammatic section showing how washout at "o" in butt-joint porcelain fillings affect color, "e" and "d" section of tooth; e' and d' filling. Note the necessary washout at o'-o of cement c that filling may match.

Fig. II. Application of the same diagram by writer to gold inlay lap-joint; "a" gold inlay; "b" section of tooth; "d" lap-joint from which there is little loss of cement "c."

During the inlay period of—say the past fifteen years—long enough in all reason to test a new principle—we note a paradox of both man and method; the same operator who formerly spent hours in attempting these perfect adaptations of gold foil to caval walls is now willing to leave them, to a degree, at least, marginally open to the wash of the saliva; proximally, in the same mouth environment, we daily see porcelain inlays with cemented joints washed out exposing enamel margins, through which the light rays pass into the porcelain, thus, in the only way matching the tooth surfaces which they restore, lying directly adjacent to gold foil operations in perfect contact with similar enamel caval margins. Both operations apparently saving tooth structure, yet based and built upon principles diametrically opposed,

can both of these methods be right? Are the countless daily converts to the cemented inlay wrong in thus forsaking axioms sanctioned by long experience? The answer to these and many other associated questions is, we believe, to be found in a study of how mechanically-made contact on the one hand and chemically-made adhesive cemented contact on the other will meet and overcome the bite stress and carious environs of the human mouth. As soon as we depart from the teachings of the forefathers, absolute marginal contact of filling material and cavity edges, we find the greatest divergence in principle and method amongst the inlay "cult" in caring for these edges, for while all inlay operators insist on an adhesive cementing media between filling and tooth, they sharply divide on the final cavo-surface finish of the filling into:

"A," Fig. I. *Butt-joint operations*, necessary from the friability of the material *in all porcelain fillings, where the cementing media is expected to wash out the depth of the width of the joint,*[12] that the filling may reflect light and match; the cavo-surface angle is at right angles, or 90 degrees, as is the filling surface angle; the joint is open to the pump of foods in bite stress when exposed, and to cement solution from mouth fluids. With the finest technique these joints in porcelain inlays can be made only as fine as the thickness of the matrix foil after burnishing. Head[1] says such joints are from 1½ to 2½ times the thickness of the foil

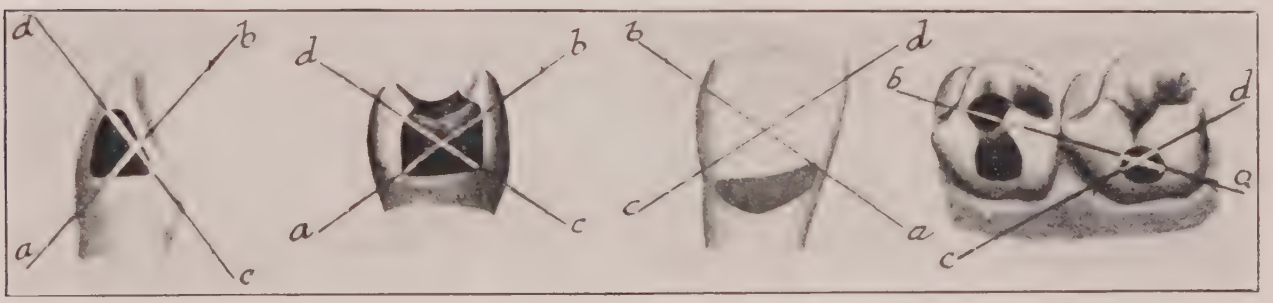


Fig. III. Cuts of filling from Black's "Operative Dentistry." Intirsecting lines made by the writer.

used (.0001 of an inch); at the best, they are as open as the size of the cement powder granules; this is necessarily limited because extremely fine powder makes cement set so rapidly as to be impractical. Poundstone[2] found only five out of all the cements studied with powder granules, after solttion in mixing fine enough to permit a joint .0001 of an inch under 25 pounds' pressure. The *butt-joint* in gold inlays is subject to all of the doubtful variations produced by contraction of wax and metal and expansion of investing material; if the inlay exactly fits the cavity it will protrude by the distance of the largest cement powder granules which have not gone down in the mix.

"B," Fig. II., *Lap-joint operations*, possible always from the ductility of the material gold and its alloys, *in all gold inlays, where the marginial cementing media is not expected to wash out* for appearances; the cavo-surface angle is anywhere from a little less than 90° to 40°, often topping enamel rods as in best foil operations; the marginal cement is protected from the pump and lave of bite stress and to a

12. Nyman, J. E.—Porcelain Problems.—*Dental Cosmos, 1905.*

1. Head, J.—Test of the Inlay Cement Problem—*Dental Cosmos, 1905.*

2. Poundstone, G. C.—Discussion of the Cement Problem in Inlay Work. Proceedings, Fourth International Congress.

degree from mouth fluids by burnishing down the lap to the enamel rods, thus taking up any protrusion made by cement granules in the cement line *which does not face* the impact of foods, as in *butt-joints*, but rather *faces directly away from it*, a great advantage.

These two great classes must be subdivided again into:

FIRST: Those which on section show the cementing media throughout the filling as only a line on the pulpal and axial walls, the filling seated mechanically in the cavity.

SECOND: Those which on section show the cementing media as a line only at the margins, appearing in bulk throughout the filling to ofttimes as much as one-third on the pulpal end axial walls; the filling may have some mechanical retention, but more is expected of the cement "en masse" as a retainer.

All of these classifications are absolutely necessary, because of the vast difference in behavior of the cement line as between butt and lap-joints in all mouths; further, it was found early in these observations, which were undertaken some years ago and have been followed up both in and out of the mouth, particularly with honed sections, that while cavities and inlays made by any method were subject as all operations should be to the rules laid down by Black,[3] there were certain exceptions to these

Fig. IV

Fig. IV. "A" butt-joint in porcelain inlay, and "B" lap-joint in gold inlay before exposure to mouth fluids and bite stress; presented for comparison with those showing use in mouth.

rules, particularly in butt-joints, in the areas of possible damage which are diagrammatically here shown, and may be known as the *vulnerable inlay areas*, defined as follows:

Dividing the proximal surfaces, Fig. III, of the incisors and canines by a right line, "a-b," which arises just at the gingivus in the labio-gingival angle and cuts the surface, emerging on the lingual surface midway between incisal and gingival; by a second right line, "c-d," which arises at the gingivus in the linguo-gingival angle, cuts the surface, emerging on the labial surface, one-third of the distance from the incisal to gingival; the proximal surface is thus divided into unequal triangles which may be termed the labial, lingual, incisal and gingival triangles, the smallest of which is the lingual. Similarly, the proximal surface of bicuspids and molars, Fig. III, may be divided by the line "a-b," which arises at the gingivus in the bucco-gingival angle and cuts this surface, emerging a little gingival to the linguo-occlusal angle, and by a second line, "c-d," which arises at the gingivus in the linguo-gingival angle, crossing the surface to emerge slightly gingival to the bucco-occlusal angle, thus dividing the proximal surface into equilateral triangles, respectively, the buccal, lingual, occlusal and gingival.

3. Black, G. V.—Operative Dentistry.

The labial surfaces of incisors and canines and the buccal surfaces of bicuspids and molars may also be so divided by the lines, "a-b," arising for the molars and bicuspids, Fig. III, at the gingivus on the mesio-gingivo-buccal angle, crossing the buccal surface and emerging at the disto-bucco-occlusal angle, crossed by the line "c-d," which arises at the gingivus in the disto-gingivo-buccal angle and emerges at the mesio-bucco-occlusal angle, dividing the surface into triangles, the gingival, occlusal, mesial and distal.

For the incisors and canines, Fig. III, the line "a-b," arises at the gingivus in the mesio-gingivo-labial angle, crossing the labial surface to emerge at the disto incisal

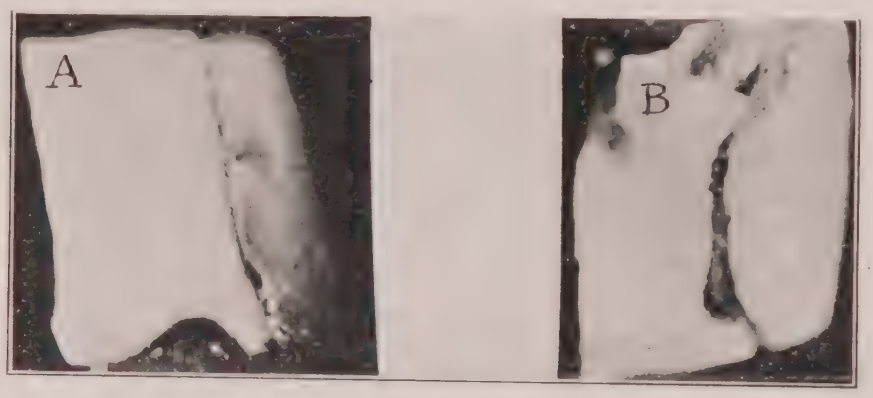


Fig. V

Fig. V. "A" lingual and "B" labial view of a porcelain inlay in bad mouth environs six years. Note the heavy bite stress shown in the enamel of the incisal edges. When set these butt-joints were above the average. Note the damage in the vulnerable mechanical areas and all down the lingual; the solution at the gingivo-labial angle and yet the washouts were not deep nor was recurrent caries noted.

angle, crossed by the line "c-d," which arises at the gingivus on the disto-gingivo-labial angle and crosses the labial surface, to emerge at the mesio-incisal angle, dividing the labial surface into triangles, the incisal, gingival, mesial and distal.

It is obvious that damage to the cement line can come from two sources, viz., mechanically from foods under bite stress, pumping or laving out the cement and

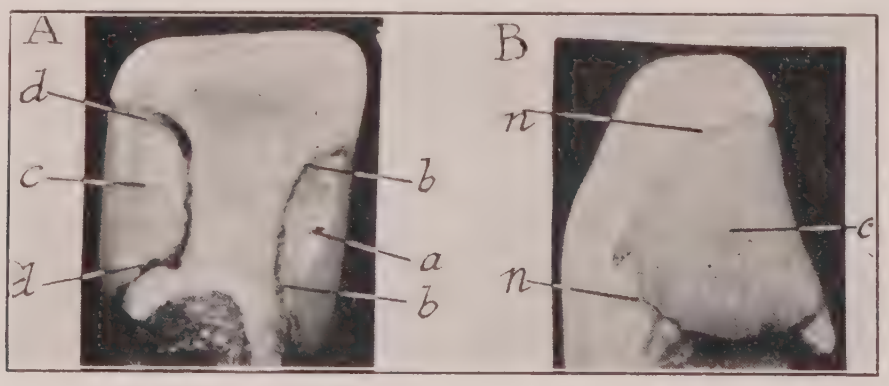


Fig. VI Fig VII

Fig. VI. The lingual view of a lateral incisor containing mesial and distal porcelain inlays placed at the same time. The mesial "a" lapped the adjacent central and was sheltered from the bite pump. Note the fairly good joint at "b" after three years. The distal inlay "c" was thus obviously more exposed to the bite with resultant joint damage at "d."

Fig. VII. Proximal view same tooth, porcelain inlay "c." Note the very good cement joint on the labial at "n." The gingival caries seen in both these pictures is due to rapid recession, is recent, and has nothing to do with the crown conditions, which were maintained for three years.

joint contents, and chemically from a solution of cement due to acidity of saliva and mucus, whether local or general. The incisal and occlusal triangles include the areas of damage by bite stress, and may be termed *the vulnerable mechanical areas*; where the lines arise in the labio-bucco and linguo-gingival angles and the incisal half of the gingival triangle are the most dangerous to the cement line from local acidity and may be termed *the vulnerable chemical areas.*

Certain areas in normal mouths appear more immune than others to cement solution, as the labial, buccal and small lingual triangles and particularly the lower half of the gingival triangle, which is sheltered by a healthy gingivus, of which more will be said later, for, indeed, it is the only shelter for this line where there is general mouth acidity.

The application of these lines should not be made too literally, and they cannot be drawn "hard and fast," as they are subject to change in inter-proximal contact,

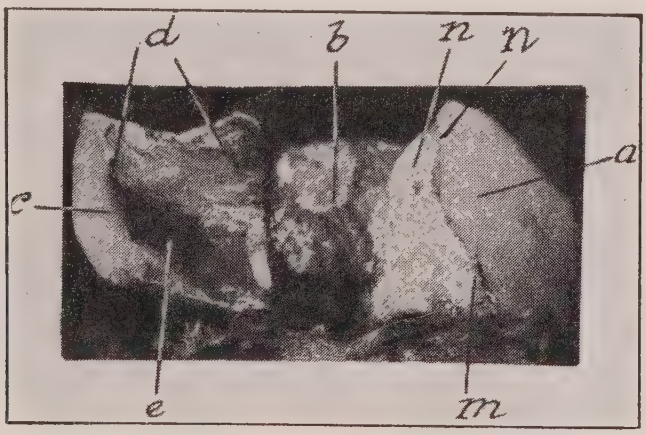


Fig. VIII

Fig. VIII. Showing a large mesio-occlusal porcelain contour; superior first bicuspid at "a," which fortunately split in attempting an occlusal section through it, and a disto-occlusal amalgam filling at "b;" "c" represents the cut occlusal portion of the buccal enamel; "d" the cavo-surface enamel parted from "a" and containing some cement; "e" the darkly stained wall from "b" amalgam filling. Note the washout on cement line being greater on the bucco-occlusal at "n" than the solution at the bucco-gingival angle at "m" from acidity.

gingival recession and the curvature of the embrasures for the proximal, and lip and cheek contact for the labial and buccal, but they give a most valuable general idea to the operator in cavity preparation.

For instance, if we take the classification of butt and lap-joints and apply the rules of these areas we find from the study of a large number of specimens both in and out of the mouth, that in:

Butt-joints, Fig. IV A, usually porcelain inlays, after a period in the mouth dependent on mouth conditions to be mentioned later for *Proximal Cavities in Incisors and Canines*, just as the operation invades *the vulnerable mechanical area* or incisal triangle, Figs. VI and VII, so is the cement pumped out sometimes to the entire depth of this triangle, or one-third the axial walls, Fig. V A; no matter how slightly the joint is exposed in the area to the lingual there is always loss of cement frequently clear through to the labial wall, with consequent loss of cavo surface enamel and filling edges, Fig. V B; there is one exception in these areas where large restorations, as the whole incisal third in canines and incisors or occlusal third in bicuspids, are

made in porcelain; here butt-joints do well on the buccal and lingual in bicuspids and the labial in incisors and canines where parallel to the incisal and occlusal surfaces the cement line is sheltered from the bite pump by a wall of porcelain opposed above it; the lingually-exposed joint is quickly pumped out and soon stands as does the enamel, alone.

Proximal Cavities in Bicuspids and Molars—Here, with even greater force, the rule for mechanical areas applies to the occlusal triangle, Fig. VIII; frequently gold inlays with butt-joints are seen in this location, but whether gold or porcelain we find the cement pumped out down along the axial wall, often over the pulpal wall, and always washed entirely from the bucco and linguo-occlusal angles.

Labial cavities for incisors and canines in the incisal triangle—The cement line does well except in erosion mouths (to be classified later), where the cavo surface margins disappear as though brushed away leaving the filling "high and dry." Fig. IX.

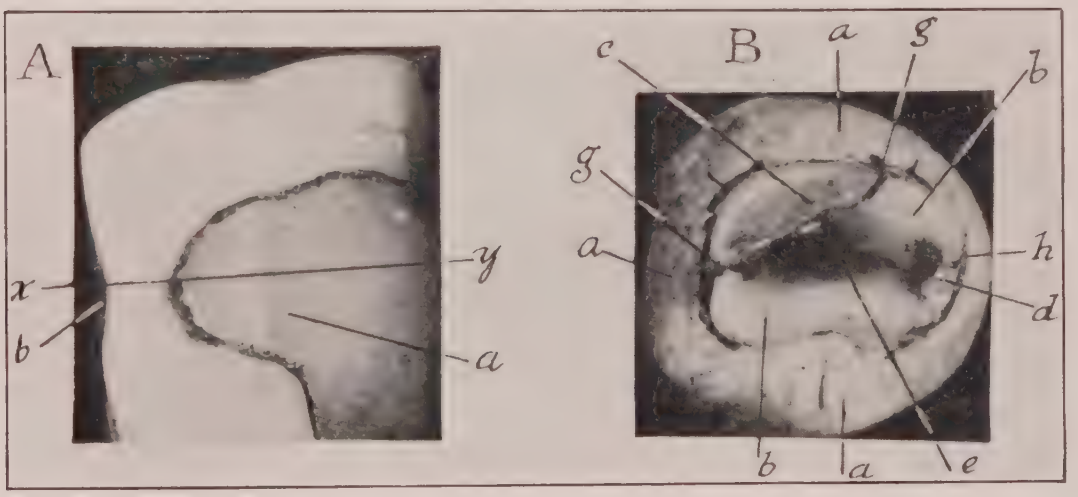


Fig. IX Fig. X

Fig. IX. Lateral incisor, large porcelain inlay at "a," time in the mouth about five years; cohesive gold filling at "b" placed some years before porcelain; stained with eosin, cut to section line x-y and honed; mouth of the erosion type.

Fig. X. Section cut at x-y retained in cement "a." Porcelain inlay section at "c," enamel and dentine at "b," gold filling section at "d;" dark area, stained cement at "e." Note the depth of washout at "g" and leakage and recurrent caries at "h."

Bicuspids and molars—In the occlusal triangle the line suffers from bite stress just in proportion as the inlay invades that triangle, and as the tooth, particularly the inferior, tilts to the occlusal, Fig. III.

Caries can and does recur after this laving process, Fig. X, when shelter is afforded for attachment of plaques, deep under the caval walls; the rule being that when the cement has laved below the depth of the enamel rods in mouths prone to caries, it begins at any shelter on the axial dentine.

Butt-joints—In the vulnerable chemical areas named, the labio-bucco and linguo-gingival angles and the upper half of the gingival triangle, or, in other words, in the usual retention centers dangerous to all contact operations, the cement line suffers, Fig. XI, from recurrent caries every time a chemical solution of cement occurs to the depth of the enamel, Fig. XII, but the percentage of its occurrence to any great depth is much smaller than the "wash-outs" in the vulnerable mechanical

areas, just as the percentage of recurring decay is very much less for inlays than for contact operations in these dangerous areas, Fig. XIII; this we may account for later dependent upon a number of modifying factors, local and general.

This is just where the variation for inlays previously mentioned comes in, from the rules of Black, for contact operations; due to this fact it is here laid down as a rule that in butt-joints, or, in other words, porcelain inlays, for no judicious operator

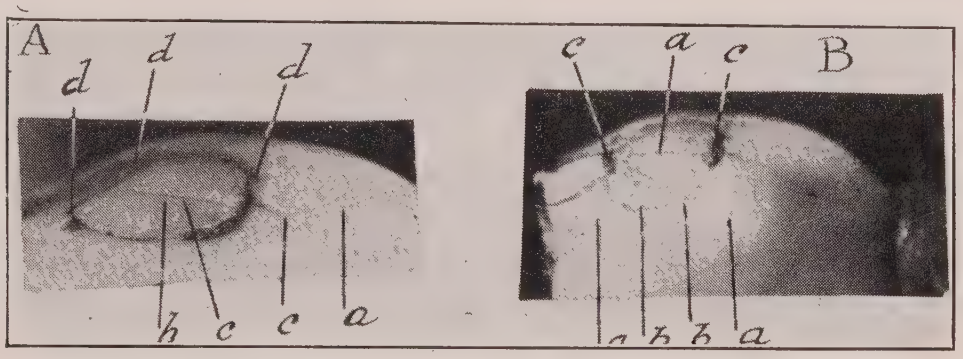


Fig. XI Fig. XII

Fig. XI. Small disto-proximal filling left superior canine stained with eosin; in use twelve years; "a" enamel, "b" porcelain filling. Note that the same drying crack "c," which split the enamel after excision, continues on through the filling, and the filling is well retained, notwithstanding the ugly washouts at "d."

Fig. XII. A section cut out of same tooth and filling on through the labial at "a" to show the state of the caval cement, which is good at "b," and the dangerous looking washout shown at "d," Fig. XI, are of little depth, the eosin stain having gone only as far as "c."

would use a butt if he could make a lap-joint, the cement line should not be extended any further out into the embrasures proximally, and particularly not extended into the incisal and occlusal triangles, than is absolutely necessary for removal of damaged tooth structures; in other words, the butt-joint operation should be "extended to

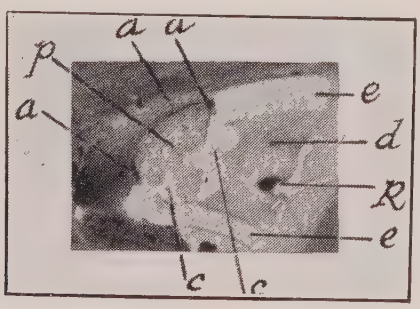


Fig. XIII

Fig. XIII Section without staining cut through proximal porcelain filling, lateral incisor; time in mouth, 13 years; "e" enamel, "d" dentine, "r" pulp cavity, "p" porcelain filling. Note the perfect condition of the cement at "c," notwithstanding the open washouts at "a" in the butt-joint, which has undoubtedly been protected by the contained film.

prevent" as little as possible, Fig.VIII, as there is more danger from the mechanical areas named in "pump out" of cement, Fig. V, than in the chemical areas named from solution of cement, Figs. VI and VII, all of which is directly opposed to the correct rules for contact operations.

Mention has been made of the shelter afforded under the normal gingivus, for here the butt-joints, as indeed joints of all operations, are at their best, and a word

is necessary as to the causes for that immunity. In a report made on "The Behavior of Certain Metals in the Mouth,"[4] the writer found all vulnerable metals as gold alloyed with zinc in solders and gold-plated german silver, as "D" bands in orthodontia, showing deep destruction of the metal just at and above the gingival margin and perfect conservation of the metal as when first placed below the gingivus; this occurred only in the normal gingivus; any irritation from fitting the band interfered with this function, when the metal was quite as much eroded as that exposed to the dangerous line directly above the margin.

It was further proven that vulnerable metals, when in fixed actual, but not pressure contact with the mucosa were not affected by the degeneration from mouth juices, which quickly attacked them at exposed parts; this was shown by a series of experimental bridges, the saddles of which, made of vulnerable metals, were placed in contact with the membranes covering the ridges; removed and examined from time to time it was found that they were clean and undamaged, where in good contact, but the exposed edges buccally and lingually were eroded. It was reasoned and so reported,[5] that this immunity might have been due to the alkalinity common to all

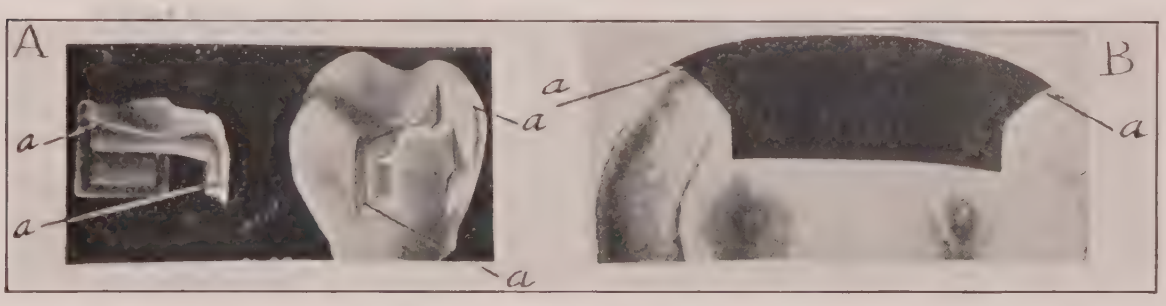


Fig. XIV.

Fig. XIV. From Conzett's article, "Gold Inlays," *Items of Interest*, to show ideal lap-joint at "a." From Black's "Operative Dentistry," wrong lap for foil operation but right lap for gold inlay at "a."

normal mucosa, but more than likely it is an illustration of the immunity conferred on all of the mouth mucosa by the constant chemiotoxis of the leucocytes. Movable membrane contact is most damaging in carious environs, witness the record written on many buccal surfaces of permanent molars as they erupt and are exposed to it in the child mouth—due to the retention afforded by the cover of the commissures. The long record of both butt and lap-joints in crowns carefully set without irritation under the gingivus, is most convincing; the cement line will stand under the protection of the gingivus in the butt-joints of comparatively flat copes of all porcelain crowns and in the lap-joints of banded crowns, the best of which are far inferior to the poorest joint made in the inlay; this might be explained, to a degree, by the protection afforded the cement by crown contour from bite stress, but for the fact that as soon as gingival recession occurs, caries recurs promptly proximally, which is also true of all operations in this locality in carious mouths. But whatever the cause for this immunity afforded by the normal gingivus, all agree that it exists, and that all operations should be put under its cover without damage to it, when possible.

Lap-joints, Fig. IV B, when correctly made with the metal ductile enough and in sufficient bulk to be well "spun" and burnished over the cavo surface angle retaining and protecting the cementing media, this grinding over and burnishing doing

4. Grieves, C. J.—The Behavior of Certain Metals in the Mouth. Proceedings, National Dental Association, 1909.

5. Grieves, C. J.—A Review of Bridge Work.—*Dental Brief*, Sept., 1910.

damage to but the finest external line of cement, the rest of which is protected thereby, Fig. XIV, are the writer's ideal, and in his judgment, a long step to the final solution of this problem, Fig. XV; after a long and careful study of lap-joints tested side by side with butt-joints, often in the same filling, Fig. XVII, in both the mechanical

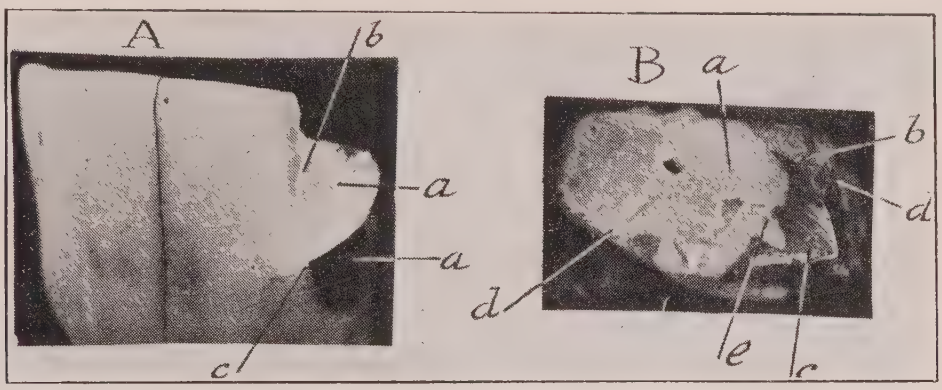


Fig. XV Fig. XVI

Fig. XV. Section gingival third gold inlay disto-proximal right superior central, showing ideal butt-joint conditions; "a" gold inlay; "b" dentine and cement, "c" butt-joint.

Fig. XVI. Section at the linguo-occlusal angle superior first bicuspid, showing successful long lap joint of a gold inlay, mouth environs bad; time, nearly four years; "a" cross section of enamel of the linguo-occlusal angle, "b" lap joint, "c" body of inlay, "e" cement in joint complete almost to cavo-surface angle, "d" investing cement to retain parts while honeing.

and chemical areas, they present conditions which are most satisfactory, Fig. XVII. There is little or no loss of cement from the lave of bite stress, for the reason that it is sheltered under the cover of the properly finished "lap," hence we may follow the laws of Black and extend occlusally, Fig. XVI, and into the embrasures; again, when the lap is properly finished—at no time an easy thing—the loss of cement by solution

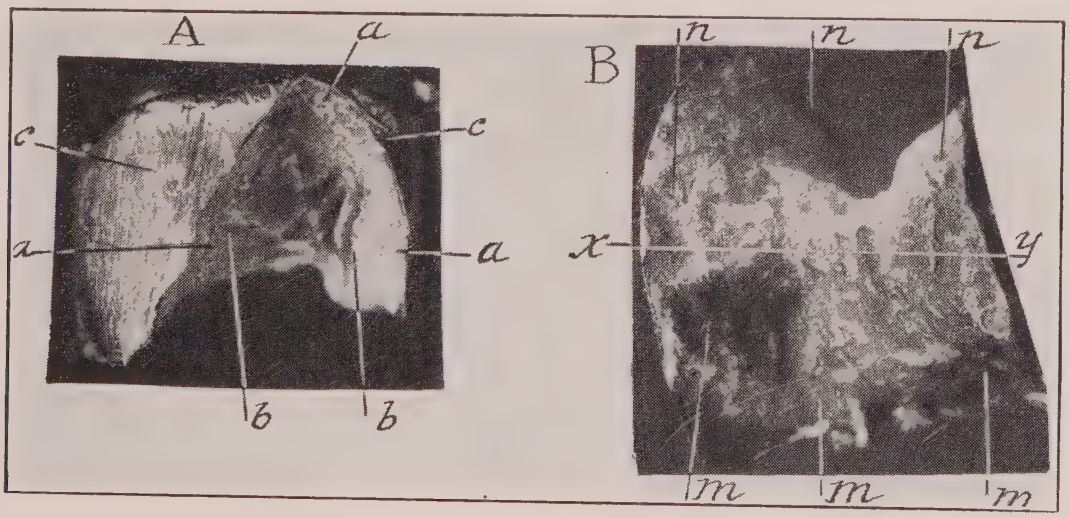


Fig. XVII

Fig. XVII. A—*Lingual view* of a mesio-disto-occlusal gold inlay, right superior first molar in use six years; "c" gold inlay surface, "b" caval cement in good condition because of perfect protection of the lingual wall by good lap joints at "a."

B—*Caval view* of same filling. The caval cement is intact on the lingual filling surface at "n" to the line x-y dividing the inlay mesio-distally. The buccal wall was protected only by a butt-joint and it will be noted that all of the caval cement buccal to the line x-v is either washed out or stained at "m.

in the dangerous chemical areas is slight, while, of course, in these areas, under certain mouth conditions, all operations fail, they stand up just as much better to the attack as the butt-joint stands better than the contact operation, Figs. XVII and XVIII. The metal in the lap-joint must meet all requirements for perfect contact finish; there is only one such, in the opinion of the writer, and that is pure gold, alloying of which seriously interferes with marginal adaptation, just as it does in foil operations, Fig. XIV; in fact, one of the principal arguments for the lap-joint is to be found in its perfect protection of the enamel rods of the cavo surface angle. The failure of the lap-joint is largely one of technique, and occurs, strange to say, just where the butt-joint is at its best, under the normal gingivus; a greater number of failures are here to be reported than at any other point, for the evident reason that the correct setting and finishing of the lap under the gingivus without damage thereto or "over-flange," causing retention, is one of the most difficult procedures in operative dentistry, Fig. XIV, and needs much betterment.[13]

It might be appropriate in this connection to mention the method applied by Levi C. Taylor, for small operations, as of building the filling of gold, usually of the

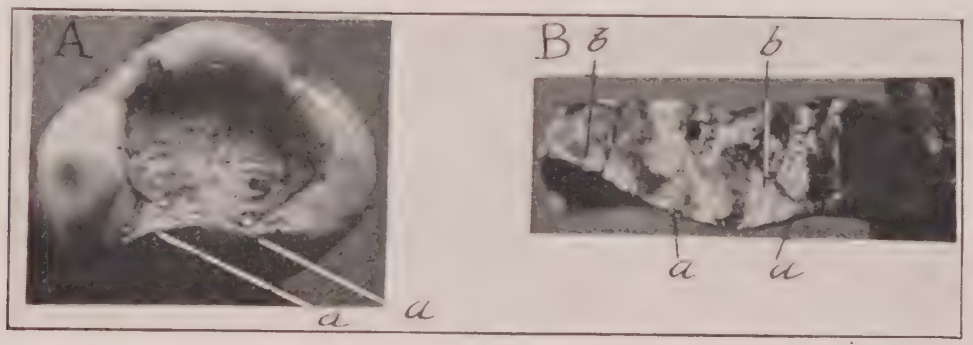


Fig. XVIII

Fig. XVIII. A—Looking into an occlusal cavity in a molar filled four years with lap-joint gold inlay, of which a section has been cut at the disto-buccal cusp, showing perfect condition of cement at "a," in fact, through the whole cavity.

B—View of the linguo wall of the inlay which filled cavity shown in A. Note the lap joint which has stood heavy morsal stress with the loss of but little cement at "a," the rest of the cement "b" is in good shape.

crystal types, in the midst of setting cement to a moderate lap-joint, Fig. XIX; a number of such have been examined, and they seem to combine the advantage of both the inlay and contact operations, also amalgam fillings after this method built of quick-setting alloy in slow-setting cement, Fig. XX, with the help of an oiled matrix,finishing to the least bit of a lap of the cavo-surface angle; under particularly unfavorable mouth conditions these fillings do well, and the writer believes that every amalgam filling should be thus cemented in.

Reference has been made to the vulnerable chemical areas, and we find mouths where all areas are vulnerable, in others chemical solution is localized; when we realize that the cement-line is continually bathed in saliva, a fluid constantly changing to reflect systemic conditions, some classification of mouth types, broad and necessarily defective, though it may be, is here necessary, to a further study of the subject. While comparatively little is known of mouth conditions—for instance, caries of the enamel is yet unsolved—certain data is at hand, thanks to the efforts of many

13. Lane, J. G.—A Comparison of Differences of Opinion.—*Dental Brief*, Feb., 1911.

authorities, particularly Miller, Williams and Black, Michael, Kirk and Low, and the writer presents this diagrammatic scheme with apologies to these investigators.

We may divide mouth types systemically into the Normal, the Hypo-acid and Hyper-acid, as follows:

Scheme of Mouth Types as Associated with the Systemic State

NORMAL

MOUTHS—Can be kept clean.

SYSTEMIC CONDITION — Biochemical changes equally balanced.

SALIVA—Neutral or alkaline.

MUCUS—Alkaline; medium in amount existing independently in ropes depositing on all surfaces.

SULPHOCYANATES—Normal, glycogen and ammonia little or none.

CARIES—Medium in amount, dark and slow.

EROSION—None.

SALIVARY CALCULUS—Medium at the usual point.

SERUMAL CALCULUS—None, frequent sulphid and other stains.

FILMS ON TEETH—On all surfaces except occlusal; alkaline or acid according to percentage of glycogen, protective except in retention centers.

INLAYS do well, and butt-joints stand, but often stain; suffer most in the stress areas, slightly in the retention centers. Figs. V, VI, VII, XI, XII, XIII, XXI.

HYPER-ACID

SYSTEMIC CONDITION—Oxidation low; increase in organic acids; Biochemical changes slow; Arthritism, showing in two phases, Erosion and Pyorrhea.

"A" EROSION MOUTHS—Which look "too" clean.

SALIVA—Acid from acid sodium phosphates, clear and limpid.

MUCUS—None, that secreted is in solution.

SULPHO CYANATES in excess.

GLYCOGEN below and AMMONIA above normal.

CARIES—None.

EROSION—In excess on cheek or lip contact.

SALIVARY AND SERUMAL CALCULUS—None, no sulphid nor other stains.

FILMS ON TEETH—A few growths open to the wash of saliva.

INLAYS—Look well but fail, particularly butt-joints from all around solution of cement due to the acid-sodium salts; other operations do well. Figs. IX, X and XXII.

"B" PYORRHEA MOUTHS—Teeth dirty cervically from gingival waste and calculi.

SALIVA—Alkaline from tissue waste.

MUCUS—Sulpho-cyanates, glycogen and ammonia above the normal.

CARIES—Little, considering the numerous retention centers caused by gingival recession.

EROSION—None.

SERUMAL AND SALIVARY CALCULUS—In excess and recurring; staining from all causes.

FILMS ON TEETH—"Materia alba," greasy, alkaline.

INLAYS and all fillings do well except in marked retention centers; butt-joints stand almost as well as lap-joints, but stain.

HYPO-ACID

DIRTY MOUTHS—Cannot be kept clean.

SYSTEMIC CONDITION—Oxidation high—decrease in organic acids; increase in excretion of saline chlorids.

SALIVA—Neutral as secreted but acid, thick and ropy; odor and color from the *Mucus —which is abnormal*, containing a high percentage of carbohydrates as excreted, highly acid, forming sordes.

SULPHO-CYANATES—And ammonia below normal.

GLYCOGEN—Greatly in excess.

CARIES—Excessive, rapid, white, and always recurs, no matter what the operation.

EROSION—None.

SALIVARY CALCULUS—In excess.

SERUMAL CALCULUS—Occasionally, sulphid and other stains in excess.

FILMS ON TEETH—A "thick acid felt" everywhere; the ideal media for B. acidii lactici.

INLAYS WITH LAP-JOINTS do better than contact operations; butt-joints fail quickly, caries recurs at all points on all operations

While it is most desirable that the individual operator should have an intimate knowledge of salivary analysis, so intricate is the subject at present it is hardly to be expected that he can apply it to his daily work; the foregoing scheme shows the principal mouth types, and a close observer may, by carefully noting conditions, read the record written on the teeth and gingivus as a geologist reads the rocks and reach a fairly accurate conclusion of existing mouth conditions.

Thus, it will be noted from the foregoing, that caries does not recur in the mouths of erosion at all and rarely in those of pyorrhea in the division classed systemically as Hyper-acid, that for instance, in the erosion types there is a coincident lack of the carbohydrate element and an excess of sulpho cyanates coupled with an absence or rapid solution of mucus, the saliva is acid because of the acid sodium and calcium salts secreted as a content of the mucus, *a systemic acidity*.

On the contrary, in the mouths classed systemically as Hypo-acid, dental caries is rampant; here the carbohydrate element is far in excess, as is the mucus, which is abnormal in quantity and quality, being thick and ropy, with the sulpho-cyanates coincidentally below normal, the saliva is again acid from the decomposition of the carbohydrate element excreted with the mucus; *a general bacterial acidity*. Lying between these extremes, and gradually merging into each, according to the variation in diatheses, is the normal, where the body processes, and consequently the excreta, through the saliva, are equally balanced, the saliva is alkaline or neutral in reaction, caries occurs, but does not recur except when retention centers are produced for the decomposition of carbohydrate foods, producing areas of *local acidity*.

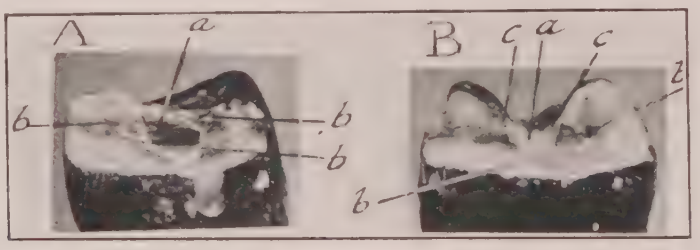


Fig. XIX Fig XX

Fig. XIX. A—Section cut through an occlusal filling of crystal gold condensed into setting cement, extracted and stained; "a" gold filling, "b" cement which is perfect. Note the conditions at the cavo-surface angles.

Fig. XX. Similar section through an amalgam filling made after the same method, same time in the mouth, similarly stained; "a" amalgam, "b" cement, owing to contraction of amalgam stains at "c", but no caries.

As all junctures between filling and tooth, and butt and lap-joints are no exception to the rule, bear much the same relation to incipient caries as do enamel faults and fissures, often creating immediately retention centers of the worst type, a better understanding is needed of the enamel surfaces, and more particularly as to what actually covers them to the dissipation or conservation of the cement line; the writer is fortunate in being able to recall to your minds these conditions in words other than his own.

Miller[7] tells of a film of micro-organism which covers the surfaces of all teeth, from 100 taken at random out of 1,000 teeth in two different experiments, and stained by eosin and the Gramm method, he says: "I was surprised at the universal presence and extent of the films; of the molars and bicuspids, only the cusps, and usually a small portion of the buccal, and less of the lingual surfaces, were found free from films; of the incisors and canines, the labial surfaces showed a film without a single exception; at the neck of the tooth, where the enamel was completely protected by the gum, there was no film. * * * Fissures, grooves, pits and depres-

7. Miller, W. D.—The Presence of Bacterial Plaques on the Surfaces of the Teeth and their Significance.—*Dental Cosmos*, 1902.

sions of all kinds are indicated by deeper staining and denser films. I was curious to see how the teeth of my colleague, Dr. York, who is immune to caries, reacted. * * * * on the whole, Dr. York's teeth, being carefully kept and highly polished, show the film restricted chiefly to the cervical portions and proximal surfaces."

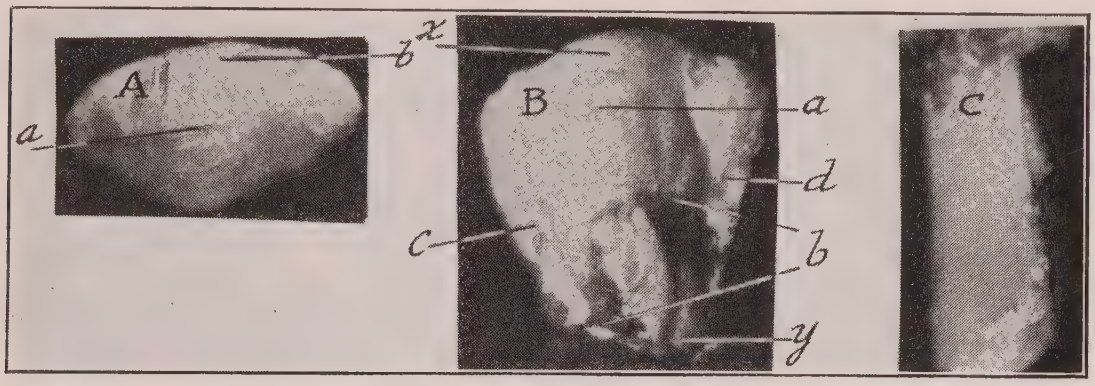


Fig. XXI

Fig. XXI Caval and lingual views of a large porcelain contour in a normal mouth about two years.

A—The gingival seat. Note that the only loss of cement is at "b," where the porcelain is exposed from solution just at the gingivus; "a" cement intact.

B—The entire pulpal wall from x gingival to y incisal; the cement "a" is perfectly preserved except at "b," where it is stained from exposure due to pump from bite stress in the incisal triangle. Note the little solution on the labial wall at "c" as compared to the deep washout at "b."

C—The lingual view showing contour, and loss of cement shown in A gingivally.

Again he says, in answering the question, Are the bacteria films or plaques restricted to carious teeth? "The question is very easily answered in the negative. They are not characteristic of carious teeth, but of dirty teeth or rather of teeth whose

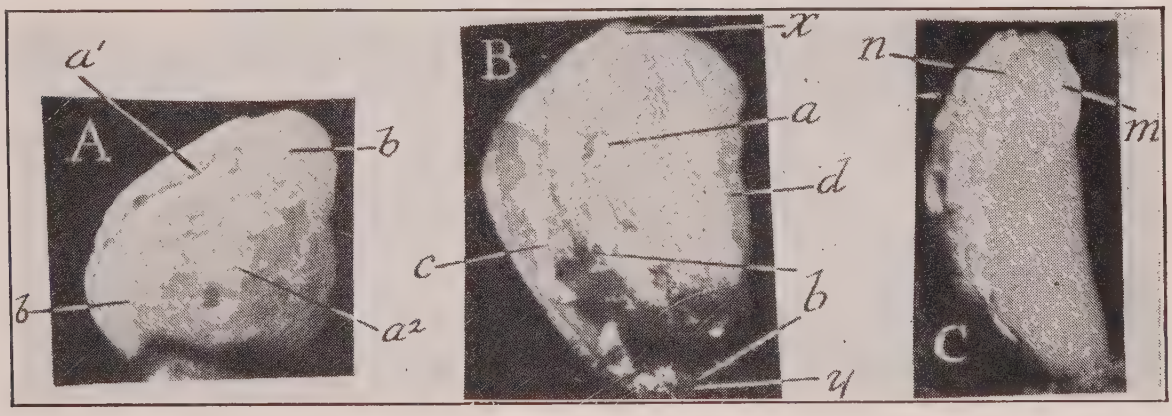


Fig. XXII
(Compare with Fig. XXI.)

Fig. XXII. Caval and lingual views of a large porcelain contour in a mouth of the erosion type, about two years.

A—The gingival seat. Note the great loss of cement at "b" in the two gingival angles where exposed to acid saliva and its protection by the gingivus at a'; the character of the caval cement at a(2) is not as good as in A, Fig. XXI.

B—The entire pulpal wall from "x" gingival to "y" incisal; the cement "a" is in poor shape, having lost its retentive value; at "b" it is stained for the same reasons as in B, Fig. XXI; it is completely lost along the entire labial and lingual at "c" and "d," allowing entrance of light rays, producing perfect color but proving the solvent power of a saliva loaded with acid sodium salts.

C—The lingual view showing contour and complete loss of cement from "n" to "m" on the linguo-gingival angle.

surfaces are not kept perfectly cleansed by either natural or artificial friction. Teeth which are not kept clean by the process of mastication; teeth without antagonists; loose teeth which oscillate in the mouth, are covered with greasy deposits ("materia alba" of Leeuewenhoek) show most abundant growths; in fact, it would be very difficult to find teeth which did not show bacteria adhering to the surfaces at some point or other."

Later he says, "We may put it down as an axiom that films will be found wherever the surfaces of the teeth are not kept free from deposits of mucus, epithelium, food, etc.," Fig. XXIII.

Lastly, in discussing the existence of the gelatinoid plaque, he remarks: "If the food accumulated on the surfaces or in the cavity undergoing fermentation, it is readily conceivable that a special growth of bacteria in immediate contact with the surface of the teeth would intensify the action at that point, though fermentation itself would certainly not be solely dependent on such growth; if there is an accumulation of nitrogenous food, or if the surface of the tooth is coated with a greasy layer of

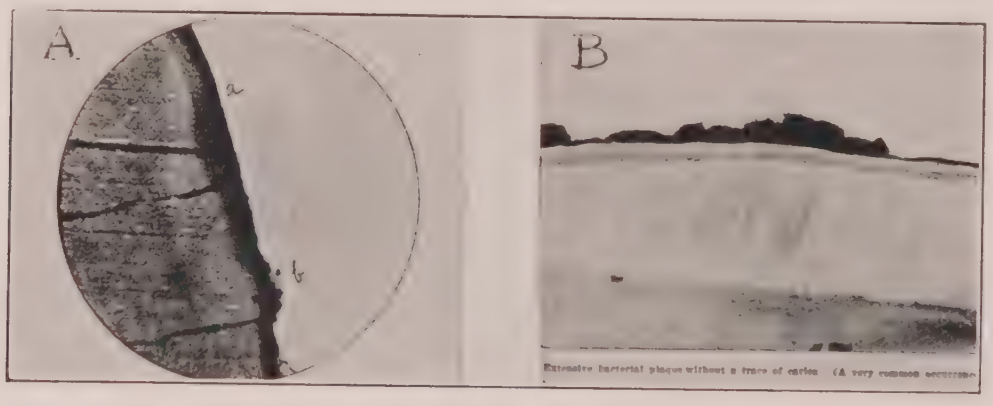


Fig. XXIII

Fig. XXIII. From Miller's "The Presence of Bacterial Plaques on the Surfaces of the Teeth and Their Significance," *Cosmos*, 1902, showing that films may occur without caries.

mucus, epithelium, etc., there will be putrid decomposition with alkaline reaction, which again may be most intense directly on the surface. *In such cases it is conceivable that the film might serve as a protection to the tooth.*" (The italics are mine.)

You will note that Miller describes these films as covering all teeth, normal as well as carious, the film consisting of mucus (to which Kirk, Lohman, etc., give 25% carbo-hydrate and 75% nitrogenous-moiety), epithelial scales, organism, etc., so the decomposition of this film in the normal would be a nitrogenous material, *putrid and alkaline*, protective in all but the retention centers for carbo-hydrate foods, which would then raise the acidity to the point of decalcification, but if the percentage of carbo-hydrate in the mucus is raised, as in the Hypo-acid diathesis, lactic acid fermentation takes place in the film and caries becomes general, unless the acid is diluted by the entrance of saliva, due to the porosity of the film.

It is interesting in this connection to quote J. Leon Williams[8] on these films under carious condition. He says: "I have ground more than four hundred sections of enamel in every stage of decay of the teeth—in one respect every specimen has shown precisely the same appearance; lining cavities or covering surfaces where decay has

8. Williams, J. Leon.—A Contribution to the Study of Pathology of Enamel.—*Dental Cosmos*, 1897.

commenced, there is always to be seen a thick felt-like mass of acid, forming micro-organisms. This mass of fungi is so dense and adhesive as to make it highly improbable that enamel is affected except in rare or special instances by any acid other than that which is being excreted by bacteria at the very point where the enamel is attacked." Fig. XXIV.

It will be seen from the above that Williams studied the film in the abnormal. He will not admit that this film may be permeated by a general mouth acidity except "in special instances," one of which we take to be erosion types mentioned before, where the films do not exist at all, or are very slight, the saliva being acid from the acid-sodium salts, the mucus which goes to make films being held in solution; it is interesting to note that these are the very types where the cement line fails most rapidly, so that it would appear that the film is protective of the cement line unless, as he says, acid be formed in and under it or "at the very point where enamel is

Fig. XXIV

Fig. XXIV. From J. Leon Williams' "A Contribution to the Study of Pathology of Enamel,' *Cosmos*, 1897, showing film present on all teeth.

attacked" under the cover of the film, and this again is most convincing, for it is the other and opposite type of mouth acidity, the Hypo-acid, where the carbohydrate percentage in the mucus is so high as to produce acid fermentation in the film.

Black disagrees sharply with Williams in associating all films with caries, saying: "It seemed that he included all manner of material that contained micro-organisms (practically any material clinging to the teeth contains them), going wide of the line of those forms known to produce caries. He seems also to have included deposits through which water would run so easily that they would be no bar to the washings by saliva; such coatings are found plentifully over the surfaces of teeth of immune persons, and also in others where there is no decay of enamel. Careful study shows that many kinds of deposits upon the teeth present similar appearances when seen in microscopic section to those produced by gelatinous plaques and yet seem to have no influence whatever on the localization of caries[3]," Fig. XXIII.

Black[10] agrees with Williams that general mouth acidity cannot produce caries,

10. Black, G. V.—Discussion of Miller's Paper: "A Study of Certain Questions Relating to the Pathology of the Teeth." Proceedings, Fourth International Dental Congress, Vol. I.

and insists that caries is due to a special gelatinoid plaque, saying: "I want it understood that I mean a gelatinous substance. I do not mean accumulations of micro-organisms loosely held together on the surface of the tooth * * * inspissated mucus * * * greasy accumulations or any of these things; I mean a substance that is gelatinoid or gelatin-like * * * not soluble or meltable as gelatin[9]. I have grown the plaque artificially, have seen it in large numbers, and I am sure that under certain dietetic conditions it is produced."

Miller and Black thus both agree that films cover all teeth and do not necessarily mean caries.

Finally, Kirk[11] condenses the whole matter thus:

"The catchy formula that 'clean teeth will not decay' is misleading, even if true in the ideal sense * * * first, because it is equally true that unclean teeth do not necessarily decay; and, second, it is practically impossible to always have clean teeth in the ideal sense. * * * For the reason just stated, dental caries cannot logically or scientifically, any more than from the standpoint of observed facts, be classed as a filth disease. * * * More particularly has attention been called to the fact that fermenting particles of carbohydrate food debris adhering to tooth surfaces is not in itself sufficient to account for the phenomena of caries of the teeth; that the mixed saliva itself contains fermentable substances as it is excreted from the glands, and that this carbohydrate product of nutrition dialyzed from the blood plasma is the element found in the saliva of caries susceptibles which is the normal pabulum of the lactic acid bacteria concerned in the first stages of tooth caries * * salivary composition is a resultant of nutrition, and that in its turn is dependent in a large degree upon food habit."

It is thus shown that the chemical composition of the saliva and the growth and chemical composition of the films forming upon enamel surfaces is dependent upon the nutritional state, and this is most impressive when we find that the cement line is damaged most rapidly and without caries in the erosion mouths of the Hyper-acid diathesis, where there is coincident acidity of saliva and solution of mucus with few films; that it suffers almost as much, attended this time by rapid caries, in the mouths of the Hypo-acid diathesis, where there is coincident acidity of saliva and excessive mucus, acid from its fermenting, carbo-hydrate content forming a thick "felt" of acid films, Fig. XXIV, and finally, it is damaged least of all in the normal mouths, where the saliva and mucus are alkaline and films grow freely, but are alkaline from putrefaction of the normal nitrogenous content, Fig. XXIII.

It would thus appear that there is also something mechanically protective against mouth fluids in normal mucus and its films when the film is not acid-producing in itself, Williams saying, "This mass of fungi is so dense and adhesive as to make it highly improbable that enamel is affected by any acid other than that which is being excreted by bacteria at the very point where enamel is attacked." and Black insists on the tough adhesive agglutination to enamel surfaces of the gelatinoid plaque, maintaining that no dilutions can occur from the fluid of the saliva under these growths, Fig. XXIV.

So we take it as proven that the only danger to the cement joint would be the excessive acidity of the contained film; the total absence or the continued displacement of the film, or so slight a growth as to allow entrance of a generally acid saliva, and

9. Black, G. V.—Discussion, Report of the Committee on Scientific Research, Dental Society, State of New York—*Dental Cosmos*, 1906.

11. Kirk, E. C.—Editorial: Prophylaxis.—*Dental Cosmos*, Feb., 1911.

while Black says, "The acidity of the general saliva does not become sufficient to cause caries. Those immune to caries have saliva fully as acid as those intensely susceptible,"[3] it must be recalled from the work of Hinkins and Head that cement is much more vulnerable to mouth acids than is enamel.

Relative to the dangers of oral mucus, you are referred to the work of Lohman,[15] who claims that mucus is the direct acting cause of all carious processes, and to Kirk[16] and Miller's[18] discussion of this theory, with which they do not at all agree only in so far as has been previously quoted; the writer[6] believes that "If mucus were destructive rather than preservative of enamel continuity, teeth in our race would cease to exist, so thoroughly are they encased by it." Of course, this is the normal mouth mucus, the same no doubt to which Head[1] refers when he says of the cement line, "The mucus gets into the fine line and acts as a capillary plug, preventing the constant interchange of solvent fluids."

The presence of a protective film in inlay joints under certain conditions now understood cannot be questioned; as to just how the film protects the contained cement, that needs further investigation.

It is the writer's idea that films fill the crevice left by the earliest washout of the superficial cement almost as soon as the inlay is set, and, as soon as they are retained, alkaline putrefaction begins and the contained film becomes alkaline and discolors; if the film is of sufficient density and agglutination, the cement line is protected until the film is displaced, Fig. XIII. If the mouth be of the Hypo-acid diathesis, with its high percentage of carbohydrate in the film, acid fermentation occurs in the contained film, the lactic acid attacks the cement, which is alkaline, to solution until the acid is neutralized and the film becomes alkaline and protective; if this is displaced, as is often the case, the process repeats itself until the "wash-out" becomes so deep and the renewed film so acid, that it cannot be neutralized by the dissolving cement under it, when decalcification of the cavo-surface enamel occurs and caries begins.

It might be argued that the ordinary decalcification of enamel would also neutralize the acidity of the attacking film, and that caries should then cease, and it does, but only to begin again, as all know who have attempted carious cultures; for when the percentage of acidity of the culture media gets too high it must be neutralized by a slight addition of alkalines; it is just this intermittent alkalinity which makes caries of enamel possible, but the amount of alkalinity produced by slow caries of enamel is small when compared with the acid neutralization possible in rapid cement solution.

There are as many stages to this process of maintaining the alkalinity of the contained film as there are gradations from the normal, from the simple neutralization of a slightly acid film, and its agglutination and retention to the dangerous combination in the vulnerable mechanical areas named, where the cement and contained films are pumped out by bite stress, only to be replaced by other deeper acid films, and so on to complete joint destruction.

This is the usual history of the destruction of the ordinary cement filling: in the occlusal areas it is washed and the film rapidly removed; in the gingival areas the film is retained, but in such mass and constantly changing that it is neutralized by the

15. Lohman, A.—A New Fact About Dental Caries.—*Archiv.*, June, 1904.
16. Kirk, E. C.—Editorial: "Mucin as a Factor in Dental Caries."—*Dental Cosmos*, 1904.
18. Miller, W. D.—New Theories Concerning Decay of Teeth.—*Dental Cosmos*, 1905.
6. Grieves, C. J.—Report of Work on Base vs. Noble Metals in Orthodontia.—*Items of Interest*, Feb., 1910.

alkalinity of the dissolving cement only to be replaced by a larger film of higher acidity, and there is no retention of film. From a protective standpoint, agglutination of the film and its retention are the most necessary things in inlay work, as shown by all these investigations, and, clinically, the rule holds good, viz., the finer the joint, the less the film; if it be acid, the less to neutralize, and the better the retention of it.

It is now easy to understand how the finest contact operations may fail while the ordinary cement-joint may stand in the same embrasure, for if the contact operation falls short at any point of absolute contact, capillarity acts, fluids enter, and the crevice fills with acid film, Fig. XXV, which so slowly attacks the cavo-surface enamel that the contained film, instead of being neutralized, receives just the percentage of alkalinity sufficient to maintain caries; in the cemented joint, as has been shown, the acidity of the film acts quickly on the more susceptible substance present, the cement, and the film is made alkaline, Fig. X, XI, XII, XIII.

With all these facts in mind the operator may approach a mouth for inlay work with some assurance of his knowledge, first of the diathesis, and by that judge how

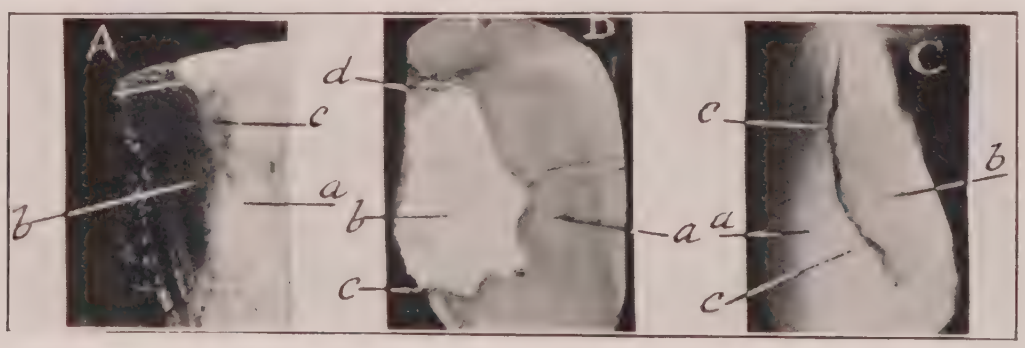


Fig. XXV

Fig. XXV. A—Linguo-incisal view of one of the best malleted gold contours the writer has ever examined, honed to the dentine; "a" dentine, "b" gold filling. Note the stain from leakage at "c" in the vulnerable incisal angle; time in the mouth, eight years.

B—A cross section cut through a bicuspid from bucco-gingival to linguo-occlusal of the best amalgam filling yet seen by the writer; "a" dentine, "b" amalgam filling, "d" edges failing from bite stress, "c" recurrent caries; time in the mouth, nine years.

C—View of the mesio-buccal angle bicuspid of a well-appearing silicate, six months in the mouth; "a" enamel, "b" silicate filling. Note the open joint at "c."

his work may stand, of the vulnerable areas in cavity preparation, and as to which type of joint he may use, porcelain and butt-joints for appearance when sheltered, or a shelter can be made by insetting in lap-joint gold inlays, which are always preferable for accuracy and durability.

Finally, the future of the method of inlaying fillings in teeth will be dark indeed, and this, the greatest boon of our times to both patient and operator, will be cast aside as "weighed and found wanting," if we, as a profession, are satisfied with present results. As seen in the light of these investigations the field is only just invaded. It will not do to accept the present cavo-surface union of porcelain inlays with the smug statement, "That joints will wash out any way, so what's the use?" any more than it will serve to be comfortably pleased with our lap-joints in gold inlays. We are convinced that both butt and lap-joints by suitable technique must be made the equal of those found in the finest foil operations. It is going to demand some of the finest science, art and skill that our profession has ever displayed to do

this thing, and we feel assured that in time the skill will be displayed, the science applied, the art demanded put to practice, for never yet have we, as a profession, failed, when convinced of the need, in the accomplishment ofttimes of the seemingly impossible.

DISCUSSION

W. T. Reeves, Chicago, Ill.: I am thoroughly in accord with all of the subject matter as Dr. Grieves has presented it. I believe that you will find that when the paper appears in print and you have had a chance to study it and to go over it not only once but several times, you will get great benefit from it.

Now, I think that Dr. Grieves has summed up his conclusions that the filling that depends upon a cemented joint has proven far superior to the contact filling, or the gold or amalgam filling as it usually has been put in. As he said in that paper, the amalgam filling that has a cement lining is far superior to the filling that has no cement under it. His conclusion came to the point that the minimum joint, and the minimum amount of cement under the filling, gives the highest degree of result. He also spoke about inlay operators differing, as to those who have a fit of the cavity throughout and those who have only a fit of the cavity at the margin and depend upon a bulk of cement in the interior of the cavity. He divides the subject as between butt joints and lap joints, and shows how it is possible to obtain lap joints with a gold inlay. It is true it is only possible to obtain lap joints with a gold inlay in the way that he has outlined, through cavity preparation. It is also true that in all butt joint operations, you are limited as to your ability to set that inlay to its place.

We will take the cavity preparation that you have been making for gold inlays—and I take it there are a greater percentage of the audience who use gold inlays than who use porcelain inlays. I believe that in all that I have seen and heard on the subject, that you are following in your cavity preparation a cavity form very similar to that advocated for gold foil fillings, that credited to Dr. Conzant, in which Dr. Grieves says is his ideal cavity preparation. I differ very decidedly from that cavity preparation. You have followed that cavity preparation through your teachings and training in the association of gold foil fillings in which you have had to have a retentive form of cavity and interlocking form of filling, and you are following out that belief that it is mechanics that also governs to a large extent the retention of inlays in your cavity. I am still preaching that it is not mechanics in any sense whatever. You may have a mechanical form of cavity that will hold that filling in, before any medium is used to hold it in the cavity. It will not dislodge, but after the filling has been set mechanics does not enter into play until the cement joint is broken—the cement joint breaks all over the cavity in one instant. Consequently your mechanical fit will not enter into play. The greater area of surface you have, the greater degree of adaptation to that surface, and consequently the greater amount of retention, the greater pounds' pressure resistance there will be to its dislodgment. I do not wish to carry the discussion away from the paper whatever, and I think the deductions of the paper bring us to the point that the minimum amount of crevice, or joint, gives us the greatest amount of security. That is, there can be less washout through mechanical force, if the cement does not wash out, and I believe it is a well established clinical fact that the cement in a well fitted inlay will not wash out but half the diameter of the crevice. Now, our object should be to obtain a fit of cavity throughout, as well as at the margins, as great as you have obtained in your cast gold inlays.

The next point is, have no butt joints at any portion of the cavity. You well know that we cannot take a flat surface of cavity and force the cement out to allow you to close that to the greatest degree possible. If your cavity preparation will take more of what might be termed a wedge shape you then may be able to set it with a minimum amount of cement. If I had a diagram (I wish I had known just what the illustrations had been, I would have made a diagram to illustrate what I want to give you as my form of a lap joint in a porcelain inlay, because I use that almost exclusively). I have a small model here that I use in teaching. It has been in use for a dozen of years, but I am afraid it is too small for you to see. If the filling enters on the wedge principle, in doing so you are able to force your inlay into the cavity and secure the minimum of joint. You will see that there is at no place anything of the nature of a butt joint.

I have seen a number of times in print and heard a number of times, and Dr Grieves has spoken to you tonight in regard to porcelain inlay men speaking of the washout of the cement in their joint as advantageous to their filling, and that it helps in the making of the porcelain to match the tooth. I do not know as I can in any way illustrate just what I would like to show you. If there is a portion that would be a butt joint, and if filled with cement, the shadow would be cast directly into the inlay, but if you prepared that so there is no butt joint, you will see that your shadow is cast downwards and backwards, so that the shadow of the cement passes out through the inlay below the median line and it does not cast a shadow into your porcelain.

Another point is the conditions of the mouth that Dr. Grieves speaks of in connection with erosion.

those conditions where porcelains look well but are soon dislodged because of the loosening of the cement. That is very true, but in the same mouths gold foil fillings fail as quickly. I have found that in that class of cases, if I extend the cavity considerably beyond the area that has been affected by the erosion, then the acid that is precipitated will be dissipated by the saliva before it reaches the margin, and those cases that formerly were soon dislodged I have had no difficulty about their remaining in the cavity.

As I said at the start, I think the great value of Dr. Grieves' paper will come to you when you are able to read it. I hope it will convince you that the inlay principle of filling teeth really is the correct principle. In a great majority of cases it will preserve more teeth than any other method that we have used. The time is late, and I thank you very much for your attention.

S. F. GILMORE, Indianapolis: The wisest man that ever lived said: "As iron sharpeneth iron, so doth the countenance of man his friend." And I want to leave it to you if your minds have not been sharpened by the countenance of Dr. Grieves, and by his paper, what he has said and what he has illustrated. As I listened to his paper the quoted proverb came into my mind—"As iron sharpeneth iron, so doth the countenance of man his friend."

I have longed for some light on this very subject that has been so well presented, and now I can say that I have the light that I sought. There is one question that forces itself upon the mind of every operator as he is giving the final and finishing touches to a filling of whatever character it may be, perhaps a beautiful gold inlay. It is a question that he asks himself, and the query is, "How long will this filling preserve this tooth; how long will it last?" and echo answers, "How long?" He says he thinks it will last for years, but as a matter of fact he doesn't know. The wish may be father to the thought.

I feel especially honored at being appointed as one to open the discussion of this paper. To discuss a paper from the pen of Dr. Grieves of Baltimore is a thing that I am utterly incapable of doing, but then, there is nothing to discuss; it is all to commend. The man who discusses usually feels called upon to differ with the essayist in some particular. In this case, to controvert is out of the question. It would be like essaying to differ with a man who said that two and two are four; there is no ground for argument. You know there are so many men who make deductions, that have their origin in fancy; they fancy they will exploit that fancy and fancy that you will believe it. And while I concede the fact that Dr. Grieves' deductions do not have their origin in fancy, but rather are the result of careful, intelligent, painstaking, scientific research and observation, yet I must have a word with Dr. Grieves on one particular point: on the matter of giving preference to a cemented joint in what is termed the vulnerable chemical area, over one of perfect contact of metal to tooth.

Now, this perfect contact of metal to tooth may be had by a properly manipulated high-grade amalgam, thoroughly burnished and perfectly adapted to the cervical wall of a cavity that is so situated as to be practically inaccessible to direct vision, or after a filling is inserted, inaccessible to even reflected vision. The class of cavities that I refer to are those deep ones on the disto-proximal surfaces of molars, superior or inferior; those dark corners where you cannot see what you are doing, or what you have done after you have done it. The insertion of an inlay in such a locality is always accompanied by a feeling of doubt on the part of the operator as to whether or not he has secured good contact at the cervical wall, as to whether or not there is proper alignment between metal and tooth surface. If his exploring point conveys the information that the gold overhangs, he finds it impossible to burnish to any advantage through the embrasures. His patient will not submit to it; all efforts to do so result in irreparable damage to the soft and sensitive tissue. If he has accidentally produced an inlay entirely free from overhang, if he has a perfect alignment between metal and tooth, what assurance has he that the shrinkage of his casting has not resulted in too fat a joint to be dependable, especially in a butt joint?

As our essayist says, "A greater number of failures may be noted at this point, the vulnerable chemical area, than at any other, for the evident reason that the correct setting and finishing of the lap under the gingivus, without damage thereto, or overflange, causing retention, is one of the most difficult procedures in operative dentistry, *and needs much betterment.*"

In my experience with inlays of the *matrix* type, I have discovered that the weak point is the cervical wall, principally in all cavities of the class referred to; that perfect adaptation and surface alignment is out of the question; and that without these important factors, recurrent caries at the gingival margin is the result in most cases. As the result of my experience along this line, I have adopted and practice what I have proven in my own experience, at least, to be a satisfactory solution of this problem: All cavities having a gingival wall or border that are not accessible to reflected vision, or satisfactory instrumentation, after the filling is seated, should, as a part of their preparation for an inlay, have at least a layer of amalgam, one or more millimeters in thickness, vigorously and thoroughly burnished to contact with said wall. A careful adaptation of the matrix will make this method an easy matter, because the modern matrix properly adapted automatically produces contact and alignment. All that is necessary is for you to apply the force.

This method carries with it the sustaining argument that the element of guess work is largely eliminated, so far as adaptation is concerned. The field of operation is brought up to a point where the operator can see what he is doing. What a comfort it would be if we could see exactly what we are doing in a large number of the operations we perform in the human mouth. What a comfort it would be if the element of guess work could be eliminated, when we are preparing for filling a canal that is filled with deleterious matter. If we could only see when we have the last bit of septic matter out of that canal, and when we have properly sterilized it for its filling; if we could see our gutta percha point carried just to the right spot. Speaking about comfort, I am tempted to tell a story:

An Irishman and a Dutchman were working side by side on a public highway, and as they worked they talked. Among the various things they talked about was the subject of what was the most delicious article of diet. The Irishman thought nothing could excel the Irish potato. The German said there was nothing that could equal Limburger cheese. The Irishman had never heard of Limburger cheese and it was new to him. The German said to him, "I will convince you; I will have my grocer send you up ten pounds of Limburger cheese and I want you to feel that you are putting your feet under a table that is groaning with the best thing it is the privilege of man to consume." When the Irishman went home that evening he saw Martha standing as he approached the house, with a cloud on her face, and she said to him, "Mike, you better not come in; well—maybe you better come in." Mike said, "Did a man bring something here?" and Martha answered, "Yes; the grocer brought something up and it is spoiled, whatever it is, and the odor of it in the house is awful. I wish you would come in." Mike agreed with his wife that whatever was sent was a mistake and was *badly* spoiled. His Irish neighbor came in for an evening call, and he sat there and talked about one thing and another. Finally his curiosity got the better of him and he said, "Mike, have you had a death in the family?" Mike was loath to acknowledge the cause of the trouble, so he thought the best way out of it was to say yes. His friend said, "Mike, was it one of the family?" and Mike said "Yes." "I hope it wasn't one of the children," and Mike said, "No, it was my mother-in-law." His friend said, "Well, Mike, it is an awful thing to lose a mother-in-law, but you have one thing to comfort you. When you come to bury her you will not be afraid she is in a trance—she is sure enough dead."

When a man puts in a gold inlay he satisfies himself in every way that it is a beautiful inlay, and his patient compliments him. In the course of time his patient comes back and takes his seat in the operating chair, and says: "You know that beautiful inlay you put in," and you pass your instrument in there and it goes into a hole, and you find debris and one thing and another. You are satisfied at once that whatever was in there is not in a trance, anyway.

I submit that the experience of every operator present and the history of every amalgam filling that has been carefully and conscientiously planted against the cervical wall of a cavity, would, if such history were available, bear me out in the statement that a smaller percentage of recurring caries may be found in what our esteemed essayist has designated as "the vulnerable chemical area," where amalgam has been employed, than that of any other filling material. If you use this method you need not give yourself much concern as to whether or not the oral secretions remain normal or change to Hyperacid or Hypoacid conditions. One of the old dependable wheel horses of the dental profession can still, as in the past, be depended upon.

Now, will you tell me of any good and valid reason why you should not employ a thin film of quick-setting amalgam under an inlay in the territory referred to, and then comfort yourself with the thought that your beautiful inlay, with its perfect lap joints, lingually, buccally and occlusally, will stand as a monument to your skill and not eventually topple over because it was undermined?

ALEXANDER JAMESON, Indianapolis, Ind.: When I received a copy of this paper by Dr. Grieves I had the feeling that the gentleman who selected me to discuss the same did not show as fine perception or as good judgment as he should have shown. I think that it requires to discuss this paper somewhat of a mechanic, a good deal of an artist, a great deal of a bacteriologist, and a man who is more or less a past master in several of the arts that the average dentist has not time to look into. In other words, it presupposes more ability than I have.

However, there are some points that I particularly want information on. It is no discussion of a paper to get up and say that it is well read and well presented. We all know that, and this paper shows a wonderful amount of investigation and research. I want to cut my remarks short and get down to the gist of the matter and find out, for instance, where this fits.

There is a lesson to be learned in everything of this kind, from every effort that is an honest effort, and this one undoubtedly is, and we want to draw our conclusions where this fits into our everyday practice and life.

We are assured that the lap joint inlay is even better than we thought it was. However, I want to get back of a few things. I have never had much doubt of one thing, and I hope you won't hit me with a brick when I say it. I believe the average man doing the average work can do a better piece of work with an inlay than he can with a gold filling. That does not prove anything, however.

Dr. Grieves has shown by a great many figures and beautiful illustrations the cement line under these fillings. He has drawn a conclusion himself that the cemented filling is better than the contact filling. On the other hand, to go back and be scientific about it, he has not given us the history of those pictures. I doubt whether there are any of those cemented fillings that are as old as some of the contact fillings that Dr. Grieves has not had a chance to see. As a clinical proposition I have got to be shown that the right kind of a contact filling isn't about right. If it is not the right kind it may fall into the hands of Dr. Grieves and be dissected and thrown upon the screen. He hasn't told us how old they were, etc. I think they both ought to be put in under the same conditions, live the same life and then be subjected to the same analysis in order to give us something that is scientific. I do not believe the doctor said where these fillings were from, how long they had been in, who put them in, nor anything about the conditions. You can take a contact filling that has been doing nice work in one mouth for four or five years, and it will fail in another mouth. The doctor himself has given us a classification that shows that any filling fails in certain mouths and others do well. Now, those classifications, according to his own statement, might obtain in a case of this kind. A contact filling may have been in one of these mouths that was not the best place for it, or a filling of any kind. The cemented filling may have been in one where there was all the advantage. Until we can get data upon these things that are absolutely conclusive, I would not feel that his conclusions were absolutely to be relied upon. I think he is along the right track. His work has shown us some wonderful results.

I differ with the doctor in one or two little things, but I do not know that it makes any difference. The doctor says that for gold inlays there is nothing but pure gold. I think that is a debatable proposition. The average gold filling is harder than the twenty- or twenty-two-karat cast inlay. We have seen many contact fillings that have the characteristic floor, and you have a cemented filling that is softer than that is. The only possible advantage that I know of for gold filling would be that it would be just a little harder than the twenty- or twenty-two-karat gold. Time will tell and tell what is the best material.

Now, Dr Grieves' ideas and theories presuppose another thing. These classifications were made. At the same time my idea is that those classifications more or less come up a good deal like the old question of temperament. We have to be an observer to tell anything about temperament, unless we make quite a study of it. We say that so and so had black hair, etc., and a certain temperament predominates.

Now, to make these classifications effective there should be in every community of dentists some man or men with a laboratory where we could send our patients and have certain tests made. We know in a general way that so and so is so. We ought to be able to send our patients to the laboratory and have certain tests made to classify them. After all, it comes down to the proposition, if he belongs to this particular class where the lap joint fillings will preserve his teeth, why not make them all lap joint? Why not be hunting for the worst kind of a case and in doing that make every filling the very best we can?

In the discussion last night there were some amusing points brought out. Dr. Gilmore makes a statement that amalgam as a base was the only thing for a gold inlay. Dr. Grieves stated that he always puts an amalgam filling in with cement. Why not get all these things together and have them all right, have them all there? I think it would be a great idea to work all these things in and have a proposition that would be worth while.

The fact remains that I have seen as a clinical proposition contact fillings that are in the mouth, that have been there as many years as some of us are old, that are doing the work. Now, they may be in those mouths that are more or less immune, but some of them are not. After all, it comes down to that proposition. The well made contact filling—well, you have to show me that it isn't all right. Still I am delighted to know that the cemented inlay is going to have such a good send-off.

Now, the answer to all this is just one thing, and the doctor suggested the answer in his paper last night, and it leads up to another trend of circumstances. Let us have cement do the work. If we go to work to get it we will get it. Let us get a cement that is acid and alkali proof and that will do the work. That brings up the story of the man who said he wished he had three hundred dollars. Someone said to him, "If you had three hundred dollars what would you do with it?" He said, "Well, if I had three hundred dollars I would buy a sawmill." His interrogator remarked that if he had three hundred dollars he wouldn't need a sawmill. If we had a cement that would do the work why would we want a gold inlay? We have to do the best we can with what we have. This cement problem, after all, is the answer to the whole proposition, in my mind.

ALEXANDER WHITE, Indianapolis, Ind.: I would like to bring out one point that Dr. Grieves mentioned last night, about the use of pure gold for all inlays. I believe he made the statement that he used pure gold for all gold inlays, and I would like to ask if there are not some indications for using twenty-two karat gold. I am asking for information, as some of our best practitioners use twenty-two karat gold almost exclusively, while others claim they use nothing but pure gold. Which is right?

I use pure gold almost exclusively, but use twenty-two karat gold in some cases, as for example, the use of inlays for bridge abutments.

Another point made by Dr. Grieves' discussion was the model a great many of you saw. I would like to ask about the gingival of that cavity preparation It is against the principles taught by Dr. Black and a great many others to make an upward slope of the gingival wall. They teach us to make a flat gingival base bevel the outer margin down, while he has the entire margin to slope upward. Knowing the anatomy of the tooth structure, I believe a cavity prepared in this way will leave short enamel rods to soon drop out, and we will have recurrence of decay at the gingival as shown by Dr. Grieves with the lantern slides.

Closing by C. J. GRIEVES, Baltimore, Md.: First I want to take up the point just made in Dr. Reeves' discussion of my paper. I would like very much to have that cast, and I want particularly to express my appreciation of what has been said in regard to that cavity preparation.

Dr. Reeves said that he made lap joints in porcelain. I think the general opinion is that the lap joint is where the cavo-surface enamel is lapped by the filling edge. That is not the result only of theory, that is the result of actual practice, as shown by Dr. Black and his confreres, and every operator knows that there must be no short rods left. The preparation made by Dr. Reeves was just the reverse of this rule. He cut under his enamel wall and left a lot of short rods which overlapped his butt joint. I noticed in the cast he presented that when it came to the incisal angle, his line was just the same as done by any other operator, his cavo-surface angle at 90 degrees, inasmuch as there was no cover then to the cavo-surface cement and it would be pumped out very quickly. Labially and lingually these short enamel rods would soon chip off; I doubt very much if they would stand.

I admire Dr. Reeves as an operator, but I have to say that much about that form of cavity preparation, inasmuch as it is just the reverse of what is practiced by every operator in all types of filling. That does not make it wrong; it may be right but I doubt it.

As to the other point, the mechanical retention, here again I will differ sharply with Dr. Reeves. He said that mechanical retention amounted to little or nothing, that the cement held the filling in the tooth. The cement is a retainer, of course, or we would not use it, but I have always thought that cement came into the joint to close that joint, simply as some adhesive media, to exclude mouth juices as between the filling and the cavo-surface enamel. If you are depending upon cement to hold your filling, why make any retention at all? The fact of the matter is that the mechanical retention I believe time will prove, after all, is the thing; the filling is retained by mechanical retention and that in turn retains the cement, and the filling must have some seat in the cavity that it may find its place.

There is a long line which we have not the time to go into. I think it has been shown by everybody who has studied cement that all cements leak. I showed some cement on the screen last night, stained one-third the depth of the walls. If they don't leak along the joints their body substance acts as a filter, filtering the saliva of the germs in the mouth and by this filtering process preventing decay of enamel. If you will experiment you will find the waterosin will go down under the cavo wall in cement fillings. So I am not willing to depend entirely upon cement as a retainer. I want mechanical retention. I only wish we could figure out some way to make a safe lap joint in porcelain. If you lap your enamel the enamel chips off and so does the porcelain when it laps.

The next point, one brought out by Dr. Gilmore, is one upon which I would like to spend some time, that about amalgam. I shall feel repaid for my trip here if I have impressed you with one thing of value: I would like to leave with you the fact that the cemented-in filling of either crystal gold or amalgam is the greatest thing in dental practice today. I have been practicing this method for eight or ten years, the method of working quick-setting amalgam in slow-setting cement in large cavities in the back of the mouth, and with the oiled matrix working in and completing your contour in amalgam you have a filling which is indeed "cemented in" with a line of cement much finer than could be made by the most expert inlay operator. If you watch those teeth for a year or two you will find there has been no discoloration of the surrounding tooth structure. All that I have said of the cemented-in amalgam I can more than accent for small fillings made of crystal golds in cement.

Personally I believe there is not an amalgam on the market today which does not materially move some time, or flow under stress, so that I would not trust Dr. Gilmore's proposition of laying amalgam bare at the gingival seat, neither do I like the association with gold in the mouth fluids. I firmly believe that the reason amalgam fillings save teeth is from the fact that they leak saliva. One of the biggest gynecologists that I know of is placing a strip of silver foil after large operations directly in contact with the exudating tissue, the silver salts take care of the wound, which becomes black and finally disappears. So I figure that the old silver amalgam filling leaks saliva, and the salts of the saliva go down into the dentine and make the tooth black, and unless the crevice be a large one you do not have recurring decay. Nine-tenths of the average amalgam fillings I believe save teeth after that fashion.

Now, in regard to Dr. Jameson's remarks, I did not want him to say what he did about the mouth classification. I do not believe that it is at all as useless as the classification of temperament. I want to see every man get to be an expert in mouth diagnosis. I believe it can be done. That little effort of mine was the result of the work of other men simply being compiled, and I believe we will get to the state where we can look into the mouth and say what has happened to that mouth. You are doing it subconsciously every day. You are governed by what you are observing of the enamel surfaces and how the work of other men has stood. You glance around that mouth and make up your mind what you are going to do in this particular instance by what has occurred in the past. Every man cannot be an analyst, as the doctor says, of saliva, and I question how much it would help him if he could, but we can have some more definite idea, which I believe can be made practically this classification.

Just as an instance—I have been applying this method for about two years in my practice. I would not put a butt joint in an erosion mouth if I could help it, because I know that the acid salts would play "hob" with my cement. That is a very broad statement. That means your patients have to have lap joint or gold fillings in their teeth. We know that porcelain butt joints are going to fail in a little while, and I would trust a lap joint of all things under these conditions, because I think the gold can beworked down to such a shape as will stand. Again, you instinctively follow the rule of the hypoacid classification, where we have everything fail in examining children. The hypoacid period is the period largely of childhood. These little children use starches, have to have them. They use sugar; it is the carbo-hydrate food period. The saliva itself reflects their body condition, being loaded with glycogen. Under these conditions—I think you all know a hypoacid mouth—(and I believe some change can be made in the diet without doing damage to the patient). You would not put porcelain fillings in the mouth of such a child of the hypoacid mouth variety. I believe that these classifications have a practical value every day.

If you keep those three figures in your mind and look through the mouth you will find that you are applying that more or less and get more skilful in it as time goes along.

In regard to the contact operation, I approach this subject with considerable temerity. Before I studied the cement line I spent a good deal of time looking at every filling I could. My method was to slip a rubber dam over every filling and put formaldehyde on the surface to harden the films, then stain these teeth after extracting and split them open that I might get caval conditions as they actually were.

I made a statement in a former paper, of which some of you have copies, that personally I believe that there has never been a contact operation made but what leaked saliva at some point. In other words, that saliva flows through the joints and under all fillings. That your contact operation succeeds, regardless of the fact that it leaks saliva, we all know, because we have all taken out hundreds of gold fillings that have been leaking, and you have seen them in scores the best of contact operations. That these fillings did not fail is due undoubtedly, I believe, first to the mouth conditions. They may have been immune mouths. But principally I believe that the protective film I described has blocked those joints, as we know it does block the cement joint, preventing the ingress of bacteria, or isolating the culture from its habitat. This is what you find in a leaking contact operation which has leaked and yet is not carious.

I also maintain that the well made inlay joint does not leak except possibly a little, the cement acting as a filter, which was clearly shown by the staining in the caval cement in my slides.

I tack my faith to pure gold, while I recognize the truth of what Dr. Gilmore has said. For the same reason that the contact operator uses his pure gold, I claim that I can make a better joint. What you are after is the cavo-surface contact between your gold lap and enamel, the lap can always be better burnished down. I think the proof of this is in the burnished inlay that we used to make of pure gold matrix and solders. I made very few joints which were as good by the old burnishing method as by the new gold; casting the gold solders or twenty-two karat plate always made a ragged edge which I could not handle, and in the effort to polish it up I often opened up a very much larger lap joint than I had planned to have.

I want to thank all the gentlemen for their courtesy and to assure them that the field is just merely opened. I have only touched one little corner of it. I think it is a field primarily of mouth classification which we dentists simply must know. We must know our environment, we must know it just as much as the physician knows his environment. We can not get on by putting in three or four types of filling just because it is the thing to do, but we must study our mouth environment, and personally I know my results will be better. I hope this paper will be torn to pieces if it is wrong, because I want it to be right.

SOME PRACTICAL POINTS ON INLAYS

By L. E. Custer, A.M., D.D.S., Dayton, Ohio.

CONDITIONS NECESSARY FOR UNIFORM CASTING

First thing necessary is an investment—a material which will neither shrink nor expand and which will withstand a high heat. For this purpose I have used a material composed of plaster of paris, one part, and highly calcined fire-clay, four parts. This possesses two advantages over plaster and silex. The fire-clay having been burned at a much higher heat than that used in casting, does not shrink during the latter act. It, moreover, possesses a valuable feature over silex. If silex is examined under a microscope it will be found to present a smooth glass-like fracture, whereas the fire-clay particles present a rough and somewhat porous surface. The advantage is obvious. The plaster ingredient in the mixture should always be as little as possible and a mix of fire-clay and plaster will contain less plaster for a given strength than a like mix of plaster and silex. A cubic inch of the above when brought to a red heat will shrink scarcely a thousandth of an inch, therefore the shrinkage of the average inlay mold would only be about one-fifth of that—too little to worry about.

The second factor is the condition of the mold at the time of casting. It should be thoroughly dried and raised to practically the same heat each time before casting. If the investment has not been thoroughly dried out steam will form at the moment of casting and prevent perfect filling of the mold. It is important to heat the investment quite hot so that any decomposition of the plaster will have taken place. If the gold is cast into an investment which may have been dried out, but which has not been heated up quite well, a slight decomposition of the plaster is produced at the moment of casting and an imperfectly filled mold is the result. An incidental advantage is also found in casting in a hot mold—the gold need not be heated so hot as where it is cast in a cold mold.

It is important to always heat the gold to as near the same degree as possible. Theoretically, it should be fluid till every recess of the mold is filled, and yet not so hot that it remains longer in a fluid state. Unless the gold quickly solidifies after being cast, although the case may have been dried and well heated, the plaster will liberate gas under melted gold and an imperfect filling will result.

The gold should be cast under the same pressure each time. There are practically only two methods of casting—compressed air and centrifugal force. When compressed air is used (steam and gas come under this head) it is important to always have a good surplus of gold so that the edges may be sealed by the weight of the fluid gold, otherwise air will leak under the gold and ruin the casting. The surplus gold in this case, especially where the basin is quite saucer-shaped, does not affect the force with which gold casts as much as where centrifugal force is used. There is no reason, therefore, unless one is hampered by a poor heat, why a good surplus of gold should not be used when casting under compressed air. Where centrifugal force is employed as the casting agent, the conditions are different and here it is especially important to use about the same amount of gold each time, allowing only for the difference in the size of the fillings. Having once ascertained what amount of

surplus gold insures a perfect casting under a given centrifugal force those conditions should be repeated as nearly as possible. The mold is easily distorted by too great a head of metal or by too high centrifugal speed.

APPROXIMAL CONTACT

No feature is so important in approximal fillings as the contact. Heretofore, this has been difficult to secure in malleted fillings, but with the cast inlay it is quite easy, and if the cast filling had no other points of advantage this would be one to recommend it. The wax filling, unless there has been ample room for its finishing, will show a small facet where it touched the neighboring tooth. This should be rounded out with wax, or as I prefer, after casting, to flow a small bit of 22 karat gold upon the facet, thus contouring it out with hard gold at the point of contact.

DO NOT DEPEND TOO MUCH UPON THE ADHESIVE PROPERTY OF THE CEMENT TO RETAIN THE FILLING

There has always been too much faith placed upon the retaining property of the cement. In order that the operation may be facilitated the walls in many cavities that might be prepared almost parallel are quite funnel-shaped in principle. This should not be. Where thin walls surround the cavity it should be kept in mind that these do not serve well to retain the filling and unless these walls are protected upon the masticating edge they will soon spring enough to break up the cemental attachment. We are prone to gauge the retentive property of a cavity by its inside form. We seldom take into consideration the thickness of the cavity wall. The loss of many fillings is due to placing too much dependence upon frail walls.

CEMENTING

If you examine a metal inlay that has come out, as a rule it will be found that the cement has broken its attachment with the tooth substance and is still adhering to the gold. This was probably due to imperfect drying of the cavity at the time of setting. The cavity walls should be thoroughly dried to insure adhesion of the cement thereto. This adhesion can be very much increased by wiping the cavity out with a little of the cement liquid and drying just before setting. This seems to prepare the surface for a stronger adhesion of the cement. We have seen the cement cling to the instrument rather than to the cavity walls at times. This is due to faulty drying out of the cavity. If it is difficult to secure the most perfect dryness it is all the more important to use the liquid method before setting.

RESTORATION OF FRACTURED ROOT BY THE CASTING METHOD

By J. Maurice Crosby, D.D.S., Bradford, Pa.

Remove the fractured portion of the root, attach a handle to the outside with wax, or better, drill and tap labial surface of fractured portion and attach a piece of German silver anchor-screw wire. This forms a very secure and convenient handle. Oil the inner surface of the fracture. Make a stiff mix of plaster into which press the fractured part of root, inner side downward, to get an impression. When set hard remove carefully. Immerse the impression in water and fill with wax, restore contour of labial surface. Remove and cast. Adapt to the root in the mouth with the crown post in proper position. Wax the inlay to post while in the mouth. Remove, invest and solder post to inlay. Replace in mouth and finish with band and cap as for Richmond crown, or a half band fitting the lingual surface may be made of wax in the mouth; remove with inlay, post, and cast to same.

EXPERIENCE AND EXPERIMENTS IN DENTAL CASTING

By J. R. Osborne, D.D.S., Shelby, N. C.

I have chosen a subject that calls for considerable employment of the first personal pronoun, and my apology for so doing is, I believe I can present some ideas I have on this subject more intelligibly and more profitably by a recital of my own failures and my own successes.

I found this work one of difficulties. There are a great many things about it that are fairly understood now that were not known when I began it, eighteen months ago.

Forcing molten gold into a previously prepared mold is about all it takes to define this process, but it implies the working of some materials not so tractable, and the employment of a technic not so "easy as falling off a log."

I agree with Dr. Taggart that "it is not a lazy man's work," but not in his statement that it will "make a poor dentist a better one," any further than to say, it might and it might not. The dentist who cannot make a good cement or a good amalgam filling, for instance, would not be the one to succeed in the casting business.

It is a work, too, that will not admit of a neglect of detail. Several conditions must be met, many kinds of work performed, the neglect of any one of which leads to failure. And there are no partial failures in this work. All failures of any kind and to any extent, are failures. Nor has it reached the stage of perfection. When some clever fellow tells us how to overcome the influence melted metal has on the walls of our mold cavities, then it will be about time for us to make proclamation that we are at or very near the goal.

Those of us who have worked incessantly and earnestly have overcome the other difficulties that gave us all so much trouble when we first embarked in this work. Let us compare notes and tell of troubles and see how nearly we are together at this time. When I began, which was just as soon as I could get a machine from the Taggart people after the announcement of the cast inlay was made in February, 1907, I found among other troubles waiting for me, something like this:

An imperfect machine.

An investing material that brought me trouble.

A model material that is not an ideal one for the work.

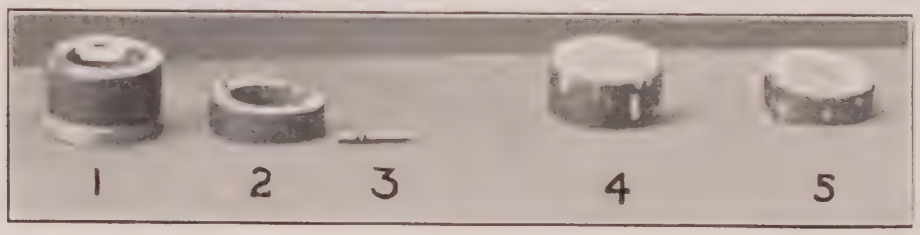
A large solid cup that caused me to endure hardness.

First, as to the machine, I do not wish to say that the Taggart machine is imperfect for the dentist who has city gas to mix with nitrous oxide gas that accompanies the outfit, but it was certainly imperfect for me, not having this gas, and of course I could not use the blow-pipe side at all.

I calculate a poor wretch in Hades with his claws cut off, and a poor dentist in a town without illuminating gas, and a Taggart machine are alike, at least in one respect—poorly equipped for what is before them. But I *had* to cast with it anyway (for I had purchased it). In *having* to cast with it, I found out a principle that has settled the *casting machine* question with me. In trying to break the joint between the machine and the cup, using a wet investment, I made a good cast with not a pound of pressure, so far as pressure from the gas is concerned. My mind reverted

to the time many years ago when I poured molten lead into a green cane. The promptness with which the lead returned was something fierce, and left me with at least two impressions, one on the inside and one on the outside of my head. But laying all jokes aside, I am here to tell you that in my opinion that same force that gave me the sore head is *the* one to drive hot gold into the mold prepared to receive it. I say this after I have had experience with not only the Taggart machine, but all the other ones of any prominence and a lot of the toys thrown in. I had a machinist here make me a machine after my own ideas. I wanted something positive and quick and now I am on Easy street.

I have used all the investment materials on the market and have found them unsatisfactory. A perfect one, so far as I know, remains to be worked out, unless Dr. Price has it in his artificial stone. I hope he has it, as this one thing will be a stumbling block until it is removed. The trouble is, it must be impervious to meet some decided requirements and not impervious to the extent that it will not take care of



Figs. 1, 2, 3, 4 and 5

the air contained in the mold previous to casting. This is but one complexity of this complex part of the work. I thought I had it fixed in the taking of a perfect impression and running a model of the tooth and cavity, and making a model of oxyphosphate cement. This gave me some big advantages that I had to turn down. Looked good to me that I did not have to remove the wax model from the cavity, as troubles more than some folks think creep in just here, in the removal of the wax from the cavity in the tooth in the mouth.

Then, again, the cement model comes out of the fire in better shape, with less change, than any of the materials in the cup. This gives us a great advantage in finishing the filling out of the mouth, an operation that the patient is not apt to find any fault with. But the cement is too dense to allow the escape of the entrapped air. I fought hard to sprue in a way that I could overcome this one fault, but except for certain pieces, I have failed. For casting a shell, this is the ideal way—using a cement model invested with the wax.

SEPARABLE CUP

I conceived early in the game that the large cup was all wrong, in that it is large and that it is solid. Wrong because it takes too long for the investment to dry out. Wrong because there is always a residue of wax enough to blacken the gold and often there is enough to do a lot more damage than that. Wrong because wax is not in all cases, in fact, in few cases, an ideal model material. I devised a cup and for the last twelve months I have used it with great satisfaction. I use a small separable cup and have changed the time necessary to dry out an investment from 40 to 60 minutes to 15 minutes. Two halves of an investment will dry out in less than half the time required for a solid mass.

One of the beauties of this idea is, I can use a model material that has many advantages over wax.

A knowledge of how to sprue is essential in using this cup if you wish to use as hard a substance as cement for a model. I have often used amalgam but I find no advantage in it over cement or modeling compound, except in certain cases. It gives a clean mold and of course a clean cast, something very much desired. Seven minutes to set, one minute to warm cup, separate and remove model, and seven more minutes to dry out (using a properly constructed dryer) and I am ready to bet on the result.

I neglected to say under the head of investing material, what I use for that. As I said, I have used all the leading materials and have experimented a whole lot, but none has served me so well as the impression and Investment Compound put up by the Consolidated people. I am not referring to the investment they put up for gold casting. It may be better than any, but if it is I do not know it, not having tried it. Returning to the cup matter, I will say that a reference to the cut will help you to get an idea of the advantages this separable cup has over the solid one.

Fig. 1. The larger half of the cup on the crucible former with sprue and model filling in position and ready for investment.

Fig. 2. The smaller half of the cup which is not placed in position until No. 1 has been filled with the investment.

Fig. 3. The sprue, threaded at one end to screw into the crucible former in order to sprue at a certain height to break investment at proper place.

Figs. 4 and 5. The cup after investing, setting, warming, separating and removal of model.

SEPARATE BASE FOR A CAST GOLD INLAY

By F. R. Henshaw, D.D.S., Indianapolis, Ind.

This applies to those compound cavities in bicuspids and molars, where it is extremely difficult to prepare the cervical portion without extensive waste of the labio-buccal and linguo-buccal margins. Prepare the proximal portion of the cavity so that it will draw, regardless of the occlusal portion. Make wax model and cast this portion of the filling. It is easy to see that you have obtained a perfect contact at the cervix, which is the crucial point in any inlay. Set this portion of the inlay and prepare the occlusal portion as for a simple case. Cast, and set the second portion and the result will amply reward you for the additional labor.

RESTORING TEETH FOR CROWN AND BRIDGE WORK BY CASTING

By C. Jensen, D.D.S., Mt. Gilead, Ohio.

No doubt every dentist has a method of his own in restoring teeth for crown and bridge work, but I think the most simple way is that of casting by the following method: First, see that the roots are in a good healthy condition, then prepare canals for pins, place pins in position, warm wax, build up and shape wax model so that you can fit crown over same, cut down wax model so as to form a slight shoulder on which crowns rest: this can be done after casting, if desired; withdraw pins with wax model, invest and cast, using Acolite; finish up cast as desired; make band as for ordinary gold crown, soldering piece of gold over end of band. Cement cast in position, then place band over cast, place warm inlay wax on band, have patient bite to obtain perfect occlusion, then carve up cusp, remove crown and cast cusp. finish up crown and cement in place, and you will have a tooth that will be serviceable in every way.

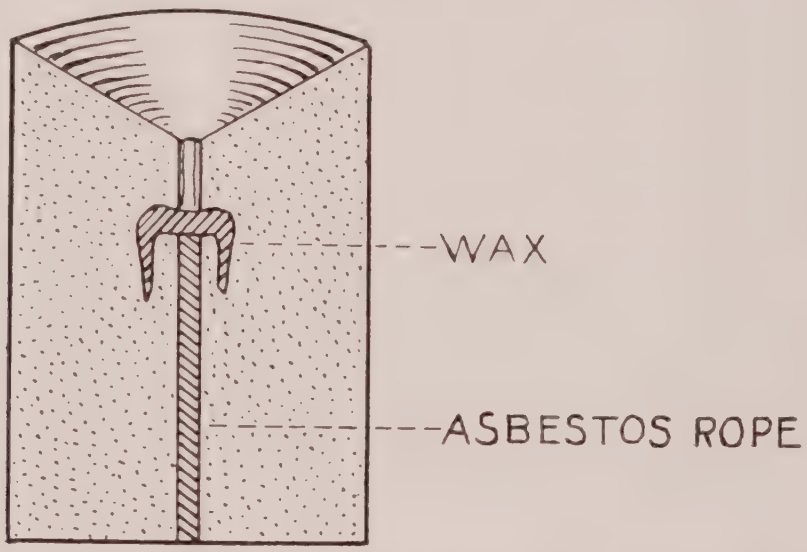
AIR VENTS IN CAST WORK

By D. D. Smith, D.D.S., Sandusky, Ohio.

The first question asked when the cast inlay came into use was, "In making the cast, where does the air get out?"

We know that the air does not always get out.

My object is to show a few ways to overcome this trouble. Some have been using a sprue wire from the base of the investment and not allowing it to come



n direct contact with the impression, but withdrawing it a little. In these cases the gold is apt to blow or suck through and thereby make a failure.

If a little asbestos rope (about the size of an engine drill) be dipped into hot paraffin and allowed to cool, it will be of great service in forming air vents in cast work. Pour up as usual and while the investment is still soft insert the asbestos rope. The wax will make the asbestos easier to handle and burns out when heated, leaving a porous passage for the escapement of air and gases.

The asbestos may come in direct contact with the inlay wax.

METHOD OF OBTAINING A SHEET OF INLAY WAX SUITABLE FOR USE AS A BASE PLATE

By Newton W. Hiatt, D.D.S., Marion, Ind.

The inlay wax is melted in small cup, so that the depth of wax is about three-fourths (¾) of an inch. A small round vial is then filled with cold water and soaped well on outside. The thickness of wax depends on the number of times the vial is dipped into the wax. It should be dipped quickly each time. After accumulating the required thickness, the wax on bottom of bottle should be trimmed off, and a warm knife run through the wax the long way of the bottle, when the wax will come off very easily. By warming this in warm water it may be adapted to any shaped model, and removed and cast as any inlay or crown. The object of the cast plate, which is particularly adapted to the lower partial plates, cast in full, or with the use of the lingual bar, is to avoid the making of metal dies, which in some cases is very difficult, and even when the metal dies are obtained it is sometimes very hard to swage, on account of the gold buckling. The cast plate overcomes all this, and can be made to fit any model perfectly.

THE MAKING OF SOLID AND HOLLOW WAX DUMMIES OF THE BICUSPID AND MOLAR TEETH

By T. C. Hutchinson, D.D.S., Decorah, Iowa.

The art of casting inlays, bridges, and the like, with the aid of pressure, has developed a great many ideas, and to the dentist whose inventive genius is given sway, who thinks and works out new possibilities to enable him to do his work more easily, more rapidly and more perfectly, the invention is of incalculable value.

With the advent of the cast inlay comes the cast bridge, which, in my opinion, will eventually supersede the soldered bridge for posterior teeth, as did the inlay displace the gold filling.

A great many dentists, in fact I may say the majority of them, have given but little of their attention to bridge work. It is a continual surprise to me to learn from time to time, as I have done, how many of my fellow practitioners overlook this very vital branch of our profession, the rebuilding of lost teeth. Nor can I understand it, for it has been my experience that no work I can do for a patient elates him more or gives him greater comfort than to supply lost teeth by bridge work. You will make a friend of any one for whom you can do artistic and serviceable work along restoration lines.

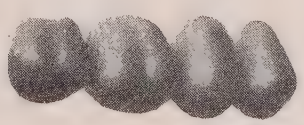


Fig. 1

For the average dentist this work should be easy to accomplish, since casting is now at hand, and with the aid of a Hutchinson Bridge Die Plate, for making wax models of the buccal and occlusal surface of the bicuspid and molar teeth, he will have no difficulty. The plate contains one hundred fifty-eight molds of said teeth, in singles, and united in twos and fours, giving ample variety to meet all cases. The teeth have true tooth-like appearance of the buccal and occlusal surface, with perfect alignment, and but a few minutes' practice will enable one to make a wax model and adapt it to the plaster model on articulator and get perfect occlusion.

Make your abutments, take the impression and bite as usual and, placing your models on the articulator, select a suitable mold on the plate for your case. If you want to make a solid gold dummy, take sheet wax, soften with hot water or a flame, roll to the size needed, then, having previously wet the mold, press the wax into it with your thumb, pressing it in as far as you can, then take a blunt pointed stick and continue the pressing until you have forced the wax to the extreme depth of the mold. (Be sure to see that the wax reaches the bucco-occlusal points of the mold.) Then finish with the thumb pressure. With a hot spatula or flexible knife trim off the surplus wax from the mold. Lift the model out and you will have a perfect tooth-like wax dummy. See Fig. 1. Cool the wax dummy in cold water and trim it to fit between abutments on articulator. Obtain the alignment (the heat of the fingers will soften the wax so that you can bend it to any desired shape), then with

the hot air syringe heat the occlusal surface, close articulator, thereby getting occlusion, or with a knife you can cut here or there as is needed to make occlusion perfect. See Fig. 2.

Fig. 2

To make a hollow wax model, select mold from the plate and then take sheet wax, soften as above and press into mold with your thumb as far as you can, then with soft vulcanite rubber press slowly and steadily, heating the wax occasionally, but be careful not to get the wax too soft as it will tear just as easily as though it were too hard. Heat it just enough to make it elastic. See Fig. 3. Trim off the surplus wax and fit to articulator as above. Cool and cast, and solder 22k. plate on back, completing your hollow dummy. You can gauge the thickness of the metal by the thickness of the wax used.

Should you want to use porcelain facings on part of the dummy, cut off the buccal surface of wax tooth or teeth, having previously backed your facing and oiled the pins. Then force the facing to place, solder the backing to the wax with hot

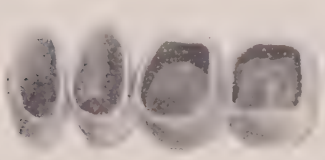


Fig. 3

Fig. 4

spatula and on the occlusal tip solder with sticky wax, bringing wax over occlusal point. Then remove the facing (note how easily it comes off) and place No. 8 or No. 9 carbon points in pin holes and cast. Drill the carbon out of the pin holes, and cement facing to place. (These carbon points are carried by the dental dealers.)

It is advisable to make your abutments and dummies in separate cast and solder together.

When you have used the above method of making posterior bridge dummies I think you will agree with me that you have made your last soldered bridge.

LATEST DEVELOPMENTS IN THE CAST GOLD PROCESS

By Albert L. Le Gro, D.D.S., Detroit, Mich.

The fundamental principles underlying the process of casting gold will, in my mind, ever remain the same and it is not the latest developments in the process that interest the practitioner of dentistry most, but the latest developments in technique and with the permission of your honorable committee I will treat the subject from that standpoint.

It is not my purpose to write of the advantages that accrue to the average dentist should he adopt the method of casting gold fillings in his practice, for I assume that from its very incipiency even the most skeptical were quick to see how it would revolutionize certain operations for good in the profession.

At this stage in the development of appliances by manufacturers it is a matter of little consequence which machine you select, though in my mind there is a difference which I will endeavor to show you later.

I have always advocated strict adherence to one method until that particular method had been mastered or found by personal experience to be inadequate. If you are using one machine and your neighbor is using another, it does not necessarily follow that because your neighbor is getting better results than you, that his machine is necessarily to be credited with his success.

In a majority of cases, it is a matter of your neighbor mastering his machine earlier and at the same time developing a technique that is more careful and complete than yours.

Analagous cases are presented in other lines of machinery, such as automobiles, for instance. Two men may have identical cars, one runs his with a minimum amount of upkeep and trouble and the other is always in trouble and finds that his way of taking care of and running his car is causing the expenditure of a large amount of money as well as time. I merely mention this to show that the man who is having trouble with a certain casting machine is by no means in an anomalous or unique position. He certainly has seen or heard of beautiful castings made by the same make of machine that he possesses, so the natural supposition is that he has left some little detail out in the process of casting which brings about his failure and he, not the particular machine, is to be blamed.

INLAY WAX

Before going into the subject of technique I would like to give you the results of my inquiries as to what ingredients should enter the make-up of a perfect inlay wax. I have found that a combination of gum dammar, carnabauer and paraffin in the proper proportions will made an ideal inlay wax that can be carved like a fine grade of clay without distorting, attendant fracture, or the use of warm instruments, a method to be deplored and forever banished in trimming wax inlays.

All except the paraffin are waxes of vegetable origin and can be readily volatilized. The use of beeswax should be avoided, as its addition even in much smaller quantities makes a much softer wax which is more difficult to carve.

Waxes that contain animal extracts such as stearin, spermaceta, etc., should be avoided as they separate from the compound in heat, especially in a flame, and they

tend to make the wax greasy and flakey. Carnabauer is the hardest and highest fusing of the waxes and is added to give the wax edge strength and hardness, and to make the compound higher fusing. The gum dammar is a hard translucent gum which gives hardness and toughness to the compound. Dammar overcomes the tendency to flake and scale which is characteristic of the wax compounds containing paraffin. The addition of paraffin makes a tough plastic compound which is easier to congeal. A small quantity of ceracin is used to prevent the wax from being brittle and a black vegetable coloring matter is added if desired. A vegetable coloring matter is recommended because it leaves no residue when the wax is burned out. Green should be avoided, as most of the greens which are usable are salts of copper and poisonous. There is a great difference in carnabauer wax on the market. Most of this wax is imported and used for making floor waxes, and while you will find some that is hard as stone, most of it is crumbly and cuts more like an inferior grade of clay. The best grade must be used for inlay wax as the quality of the wax depends largely on the quality of the carnabauer used. I know of no other wax on the market that suits me so well as that manufactured by the Ransom & Randolph Co.; this comes very near to being just what we want. The busy dentist has little time to experiment with matters so small even though he should be thoroughly acquainted with the ingredients and quality of same, that enters into the make-up of such a compound.

That I may more clearly explain some of my theories as to cause and effect in casting gold it is necessary that I treat of the crystallization of the different grades of gold and the metallurgy of that metal to some extent also. If you will take four nuggets of gold of 18, 20, 22 and 24 karats respectively, and bring them to a dancing molten state and then quickly remove the flame, you will notice that the mass of pure gold, in crystallizing, retains practically the same shape in a crystallized form as it did in a fused state. The 22k. will flatten some; the 20k. a little more and the 18k. will be perceptibly flattened. The natural deduction is that the molecules of the gold in the 24k. have the greatest tendency to retain a fixed relative position, and as you go down the scale it becomes very necessary to use more definite pressure on lower grades than on the pure in casting.

The pure gold, the melting point of which is 2012 degrees Fahrenheit, and much higher than the lower grades, necessarily crystallizes much slower than the others. About 30 seconds is necessary for the complete crystallization of pure gold; and right here I would like to tell you why I think some machines are better than others, even though beautiful work is accomplished with any of them. When molten gold is forced into a cavity, whether it be by air, centrifugal force or steam pressure, each molecule of the gold used is supposed to have a definite relative position. During the first few seconds in the process of crystallization, pressure should be definite to accomplish this, not increased or decreased, and some means should be furnished by the manufacturers of machines that admit of an intelligent understanding by the dentist of what is going on in the way of pressure during the entire process of crystallization. If a machine is not constructed on those lines it should at least admit of the slight increase of pressure from time of application until complete crystallization has taken place. In experiments conducted by myself about a year ago I learned that a definite pressure of 4 pounds, if absolutely definite during the entire time of crystallizing, was infinitely more accurate than those that ranged from 30 pounds down, with no fixed pressure at any time. My own supposition is that the molecules were not held in their correct relative position during the entire period of crystallization

and though the inlays were just as perfect to the naked eye, they did not fit into the cavity with the nicety that the one of 4 pounds' definite pressure did. Even greater discrepancy is shown in the use of different grades of gold. The common alloys of gold are silver and copper, either one of which tends to make the gold more sluggish than the pure gold. The lines in the finished casting of an alloyed gold are not as sharp and it is therefore not deemed advisable to use anything but pure gold in cavities of extreme shape, for it is a rare case that presents no defects when the lower grades of gold are used. If alloyed gold must be used, I would suggest that gold alloyed with copper or platinum or both be used. Copper does not materially lessen the malleability of gold, while at the same time it hardens it. Silver is objectionable at all times as an alloy for gold that is used in casting. It has been recently recommended by some well known dentist on account of the color produced, but it is a mistake to use gold alloyed with this metal, for aside from making the gold very sluggish, it has little edge strength and will not make what I call a perfect inlay in cavities of extreme shape.

With a little experience you can learn to distinguish the alloy in any gold combination on sight. A yellow tint generally indicates equal parts of silver and copper. A red tint, an excess of copper. A green tint, an excess of silver. One of the most desirable alloys for cast inlay work is composed of Gold, 22 Dwts., Plat., 18 Grs., Copper, 3 Grs. It is a rather difficult alloy to produce but makes a sharper casting than any other I have been able to find as there is very little oxidation compared with 18, 20 and 22k. golds that are alloyed with silver and copper. I do not recommend this alloy for its ductility or malleability, for, like most of the alloys, it is sadly deficient, but it is much superior to gold alloyed with silver as regards color and will make a sharper casting.

In regard to the latest developments in technique—there are a multiplicity of methods, all of which it is not my purpose to treat. I will confine my remarks to the little hints that my own personal observation and experience have taught me. As you all know, the possibilities of this work are only limited by the skill and ingenuity of the man. So many different possibilities suggest themselves to different men in this work that it would be presumptuous on my part to attempt to tell you of all the new things that everyone has worked out.

In the May and June, 1908, numbers of the *Items of Interest* are two very interesting papers by Dr. Price, of Cleveland, which are well worth the time of any dentist, and while the deductions of Dr. Price are not verified by my own personal experience, there is much of interest in these articles that show thought and study. These articles come the nearest to working out the problem and are the only papers on casting gold that I have read that exhibit an intelligent knowledge of the conditions as they are.

SECTIONAL INLAYS

These are used only in cavities of extreme shape where the caries has attacked the tooth to such an extent that it becomes necessary to retain all the solid tooth structure that is left. Take a cavity in a large molar approximal involving the occlusal angle with the diameter bucco-lingually much larger at the cervical than at the occlusal portion. The cavity is so large bucco-lingually at the cervical portion that in order to prepare a solid or one-piece inlay, it would be necessary to cut down a considerable portion of good solid tooth structure. To avoid this the sectional inlays or two-piece inlays are employed. These inlays should be made hollow by carving the wax inlay or by the use of suction and heat. I have been using a suction

apparatus that is now on the market and while it is a great improvement over the carving, it is quite crude. This defect will be overcome, I have no doubt, as the evolution of casting gold progresses in dentistry. The orifice of the hollow cavities should be so carved that where the two sections are in place the cement will form one solid mass running from the hollow in one section to the hollow in another.

Some one has suggested the use of ethyl chloride on cotton for chilling wax inlays. I have found it very satisfactory also in rubbing a smooth surface on the outside of wax inlays. When the wax inlay is removed from the mouth it should be washed in soda water to remove the mucus which sometimes produces a surface on the gold inlay that you cannot account for otherwise.

DITTMAR CAST SHELL CROWN

I shall describe the Dittmar method for casting a cast gold shell crown, for I think it the most perfect gold crown ever constructed. If you must put on gold crowns and can get a good fee for them, the Dittmar method will enable you to portray nature as no other method will and at the same time enable you to construct a crown that will give the minimum amount of irritation to the gums. After the root and remaining part of crown have been ground down properly, take 34 gauge pure gold, make band to fit. This gold is so thin and soft that an absolute fit can be burnished slightly under the gum. Trim band proper height for top to be soldered, which completes an ordinary box cap. Have the top and band fit accurately so that the minimum amount of 22k. gold, not solder, will be used to solder the two together. I recommend 22k. gold for soldering for without it, the gold used in casting will melt a lower grade of solder and percolate or rather be forced in fine films up inside of the band. When cap is completed place on root and with modeling compound in a double articulating impression tray, take the bite and impression at the same time. Articulate plaster for articulating side and inlay investment compound for crown side and paint the adjoining teeth with oil. Now heat up a quantity of inlay wax and use camel's hair brush to build up wax on the cap to proper contour and articulation, smooth surface with chloroform, saw off adjoining teeth and then the waxed crown. Invest and cast. The possibilities here are great and most beautiful work can be accomplished.

GOLD AND TIN INLAYS

To use an inlay made of a layer of tin and over it a layer of gold at first thought seems a good procedure, but the only argument that I can see logical in its favor is the economy of gold. A combination tin and gold inlay can have no other particular advantage over a gold inlay for the layer of cement must come between the inlay and tooth substance and all the arguments used in favor of tin at the cervical third or half of the cavity are lost. The ideal procedure is to insert the tin with pluggers, burnish the top and then make a cast inlay of gold to finish the operation. To make a combination tin and gold cast inlay is somewhat difficult, at least it has been so in my own experience. After preparing the cavity a wax inlay is made of the cervical third or half of cavity. The top of this wax is made smooth and then oiled. On top of this another wax inlay is made to come flush with borders of remaining portion of cavity and to restore occlusal and approximal contour. This part of wax is then removed and cast, leaving the cervical portion of wax still in cavity. When the occlusal portion is cast the gold is heated slightly, placed in position in the cavity and then withdrawn, when the cervical portion or remaining wax will be seen to be attached to the gold already cast. Now comes the most difficult part of

the operation. Gold has a great affinity for tin and the flask holding the investment must be at about an exact temperature to cast the tin. Tin melts at 442 degrees Fahrenheit and is not sensibly volatile, so if the investment is heated until the wax is entirely burned out of the investment and there is no formation of gases continuing and then allowed to cool until about 400 degrees Fahrenheit, melting the tin now with blow-pipe, using no more than the required heat of about 450 degrees, a successful casting on the gold inlay can be made.

If these instructions are not followed out, the gold under a greater degree of heat will entirely absorb the tin and a brittle lead color mass will be the result. Hydrochloric acid must not be used under any circumstances to pickle the filling as tin dissolves in the acid with the evolution of hydrogen and formation of Stannous Chloride.

COMBINATION GOLD AND PORCELAIN INLAYS

One of the most satisfactory operations in large restorations is the gold inlay with porcelain face baked in. The inlay is made in the usual way, preferably with platinum alloyed gold. The wax inlay is carved out or sucked out with heat and air on the wax corresponding with the portion to be restored in porcelain, with undercuts. After the inlay is made, Jenkins porcelain is baked in and an esthetic result is accomplished. Before baking in the enamel, place gold inlay in cavity, burnish borders and reduce line of gold on exposed border between margin and cavity for porcelain to a minimum so that the line of gold will be almost imperceptible when work is finished.

PORCELAIN CROWN WITH CAST CAP AND DOWEL FOR BADLY BROKEN DOWN ROOTS

This is a branch of the work of Drs. F. Ward Howlett and C. J. Lyons, of Jackson, Mich. They have worked together practically in producing a technique that gives very fine results in these extreme cases of badly broken down roots. I first saw the work of both these gentlemen, introduced at Indianapolis, early last year, and after mastering it to some extent have gotten very satisfactory results in my own practice. An article on the subject, with detail drawings by Dr. Howlett, appeared in the January issue of The Dental Summary. Every dentist should read it. I will give briefly the technique:

HOWLETT'S CROWN

A bite is taken over the abutment to be crowned with Stent's modeling compound, which is very hard when cold. The compound is then carved to fill the space and imitate the crown to be restored. A thin platinum matrix is then swaged to the occlusal surface of the tooth which has been built up and carved from the compound. This matrix is then removed from the carved tooth and filled with porcelain by a series of bakings which results in a cap of porcelain such as might be stamped from gold in the die plate for a gold crown or bridge dummy. A second matrix of platinum is made on the root stump or abutment and porcelain built onto it, restoring a considerable part of the tooth. This is then placed on the stump in the mouth and the occlusal part of the crown first made is waxed on top of it and the patient forces it to proper occlusion while the intervening wax holds the two sections of porcelain together and in place. The crown is then removed from the mouth and a portion of the wax removed and replaced with porcelain. Then the rest of the wax is removed and the space filled with porcelain and the whole crown is fused together into one piece.

LYON'S CROWN

Dr. C. J. Lyon's crown, which differs somewhat from that of Dr. Howlett's, though the fundamentals are practically the same, is a porcelain crown with cast cap and dowel for badly broken down roots. Use iridio-platinum post gauge 20 as a matrix for carrying wax into the root, letting the wax extend over the gingival margins of the root. This should then be carved to form a plate for the crown; a square post should be formed in wax about 5 millimeters long and set in the middle of the plate for the reception of the crown. The wax model of the cap and dowel is then cast in pure gold with the iridio-platinum wire in the center, after which it is polished and set in the root. A platinum matrix is next made of the plate and post by forming a tube for the post and soldering to a square piece of platinum; afterwards it is burnished to a perfect adaptation to the plate and post. A Davis crown is used for the body of the porcelain crown by grinding out a section from mesial to distal large enough to accommodate the post. This is waxed in position over the matrix and all withdrawn and Consolidated body packed around the matrix and fused. After the crown is completed the matrix is removed from the crown and the crown is cemented to the cap and dowel.

BRIDGE WORK

Those who have had experience in casting bridges in one piece will agree with me that it is entirely the wrong procedure and especially where inlay abutments are employed. There is no known investment compound that when set, even under perfect conditions, will expand enough to compensate for the contraction of gold when crystallizing. It is therefore necessary to cast bridges in sections and solder together in order to get exact results.

The fallacy of casting directly onto porcelain, I think, is quite well recognized. Such methods have no other claim to general adoption than that they are an "easy and rapid method or means of obtaining a result which cannot be wholly successful."

In conclusion I will say that it has not been the object of the writer to assume that there is any "only way" in the processes of casting gold, and while the subject given me by your committee is not one that I could possibly stick to the text on, my initial object will be accomplished if this paper but serves as a stimulus to bring out many instructive facts that you all must possess on this subject.

DISCUSSION

DR. M. R. MUIR, Detroit: Cast gold inlay work is not yet two years old, and everybody has his own little ideas, and we should have an expression from everyone here tonight who has had any experience in this work. I hoped to have some specimens to show you tonight, but I have only one which is a practical case that I made this afternoon—a bicuspid crown with a porcelain face in it. The facing was removed and gold cast with lead pencil points in the pin holes to keep them open, and the facing is then attached by cement.

The subject of Dr. LeGro's paper must necessarily bring out the results of his own experience, and as it is largely original it is of much more interest than if he had obtained his ideas from books and magazines to which we all have access.

The latest processes in cast gold work are being developed by dentists every day in their own offices as the possibilities of the work done, by casting gold is, as the essayist says, limited only by the ability of the operator. There has been comparatively little on this work in the dental journals in the last eight or ten months; nothing important during that time in the *Items of Interest* or the *Cosmos*, with the exceptions of the results of the work done by Dr. Price, as given in his splendid articles appearing in the May, June and December, 1908, *Items*.

The seed was sown by Dr. Taggart when he addressed the Odontological Society of New York, just two years ago tomorrow, giving to the profession the results of his labors and since that time it has taken root and flourished in nearly every dentist's office in the country. Numerous kinds of machines have been designed with a view to economy and the use of the cast gold inlay has been unmercifully

abused by some. Dr. Hasley, in the January, 1909, *Items*, says that some of the machines are so far removed in form and action from the usual workroom appliances that until seen in operation they might pass for caricatures. One's thumb guarded by a wet rag, has been found sufficient to force molten gold into a mold so as to produce an acceptable inlay. Compressed air, steam, gun powder, inertia, centrifugal force and atmospheric pressure brought into action by an exhaust pump, a pill box, a child's toy tin pail swung around one's head, a pair of tongs, a Yankee clock, an old fashioned coffee mill, and a hundred and one such like devices have been suggested in the dental journal for inlay castings. Just here let me quote an expression of Dr. Price: "You are disappointed just in proportion to the height of your ideals." Therefore, I would say, govern yourselves accordingly in selecting a machine.

I agree with the essayist in advocating a strict adherence to one method or machine that you know others to be getting good results with, stick to it yourself until you get results. Exactly the same can be said about inlay wax. I can get the same results with the wax I use that you can get with the wax you use, and you can get the same results with the wax you use that I can get with the wax I use, which goes to prove that the wax for you to use is the wax that you know how to use.

There are several substitutes for pure gold which might be used in casting for anything but inlay work. My experience has been that nothing takes the place of pure gold for a perfect inlay. The only argument to be put up in favor of the alloy or any other material that might be used is economy, but I would not consider that, as the time consumed is the same and results are not as good, when alloys are used.

Sectional inlays are often employed to good advantage and are sometimes necessary to avoid unnecessary cutting. If there is an undercut and the overhanging walls are good and strong, fill it with cement before taking the impression. After the sidewalls and margins are prepared, if there still remains decay in the bottom that if removed would make an undercut, take the impression and remove the decay after. A great many are of the opinion that grooves placed so and so in the cavity and in the inlay for the cement to lodge in help materially to hold the inlay in its place, but I believe that the less cement you have between the inlay and the tooth the stronger and more permanent it will be. I had that ground into me by Dr Reeves and it is still there.

On account of the perfect fit obtained with the cast gold inlay by burnishing, in certain cases with plenty of mechanical retention one can afford to sacrifice some of the strength given by the cement and I frequently hollow out large inlays with the Roach suction wax carver to save using so much gold, or to make a layer of cement over the pulp to protect it from thermal changes. Your inlay will fit better and give better satisfaction if you will clean it with hydrofluoric acid after casting. A porcelain face may be baked into a gold inlay, or the cavity can be prepared in the inlay before setting and after it is set proceed in the usual way to make the porcelain inlay.

I do not know of a better way for chilling and removing wax inlays from the cavity than the following: In the left hand hold a small abscess syringe with platinum point filled with cold water and with the right hand heat the end of a piece of copper wire about two inches long over a flame and insert it into the wax inlay—immediately then put a stream of cold water on the wire and the inlay—this holds the wire in its place. The water all going directly to the place where needed and the point of the syringe being small, the amount of water used is small. While cooling the inlay with the left hand pick up the pliers with the right, grasp the wire close to the inlay and remove. At this point clean it off with a cold air blast from your air syringe, using from 10 to 20 pounds' pressure. To remove the inlay from the wire, heat the wire in the center over a small flame and the inlay will fall off. A good wax inlay can easily be spoiled by hooking an exploring point into it and pulling and partly shoving it out as is necessary, especially if it fits tightly as it should. I do not think there is a machine made that will cast a plate or bridge without getting some shrinkage, enough so that it will not fit; I have never seen any, and have tried it—unless it can be done with Dr. Price's artificial stone. He claims great things for that, and I hope that he will be at our February clinic, and I will let him speak for himself at that time. That artificial stone, if it is not perfected now, I think will be some day, and will be the only method of casting large inlays, plates or bridges. A bridge can be cast separately, the dummies, and then the parts soldered together, but I do not think that there is a machine made that will cast a large bridge or plate that will fit.

Dr. M. L. Ward, Ann Arbor: There are two points that the essayist brought out that I would like to emphasize. The first and most important one was in regard to the kind of gold. I was of the impression some time ago that only pure gold could be cast successfully. I am of the same opinion still so far as most fillings are concerned, because the pure gold admits being finished better to the margins. I am not certain, however, that it is the only one that we can depend upon for some other kinds of work. Day before yesterday I cast a practical case out of 18K gold plate, by cooling the mold down before casting. It appears to me that the great trouble is not entirely with the shrinkage of the gold

but in the manner of handling it. Everybody has an idea that they should cast inlays into a hot mold while in foundry work it is just the reverse, and so far as I can see, it should be so here. Gold will shrink on cooling, but it will shrink much less if cast into a mold cool enough to be handled in the hands, than it will if it is cast into a mold that is glowing hot. I believe 18, 20 and 22K. plates can be cast reasonably accurately into abutments, saddles, etc , and there will be little more shrinkage if any at all than if they were made of pure gold. Such golds, however, will not make nice margins for fillings. If the gold is heated with the ordinary blow-pipe the whole investment is usually heated much too hot. The heating of the gold should be done with the oxyhydrogen blow-pipe, using a small flame so that the investment remains cool. Even though the small flame is used with the oxyhydrogen blow-pipe it takes only a few seconds to melt the gold to the proper state of fluidity I cannot speak with too much emphasis about the necessity for not overheating the investment and the necessity for casting into a cool mold if we get the minimum amount of shrinkage of the gold.

Another thing of importance in this work is the pressure under which the gold is cast. I have found that all of the present investments are too weak to stand sudden high pressures and those that have been overheated are especially weak. Almost all of them, one or two of them fundamentally strong ones, will stand open flame of the Bunsen burner from eight to fifteen minutes without a great deterioration in strength, though every minute or two beyond fifteen minutes seems to convert it into a dry powder. Another thing of importance in the casting process is the keeping of the gold at the proper condition as regards fluidity. All of the golds almost lose their identity after being cast the third time. They take up contamination from the investment in the form of iron, and iron is found in all of the investments Gold will become contaminated from the blow-pipes sufficiently to prevent its casting perfectly. A good thing to correct this is to melt the gold and place upon it gradually, keeping it melted all the time, equal parts of potassium nitrate and borax. The flame should be directed onto the gold from one side until it is melted, and little by little add the potassium nitrate and borax. Usually three or four minutes is sufficient, but if it is desired to raise the karat considerably, it will take somewhat longer than this. The oxygen supplied by the potassium nitrate oxidizes the base metals and they are carried away in the slag. This is a standard dry process for refining gold and one which every dentist can use to advantage in connection with the casting process. It is both clean and handy and is particularly effective in removing iron as well as many of the other contaminations found in gold that has been used for casting.

Dr. S. Becker: I would like to hear from some one, his experience with Acolite, which I have used considerably for attaching porcelain crowns to badly decayed roots. I expected to find something in the paper on this material. I have used it considerably. In fact, I have not put on a Davis crown since June without either a gold or Acolite fitting. I have used the gold for large crowns once or twice, but it takes so much gold as to be prohibitive. Acolite has a good sharp edge but has no strength. I do not like to cast gold on the porcelain, for the reason that we are liable to check the porcelain, because of the difference in expansion of porcelain platinum pins in the tooth and the gold used in casting. I do not think Acolite has been generally used for so long but what we want to know some more about it. Many people cannot afford to pay for the gold, especially in attaching Logan crowns, where you will often find there is a big space on the lingual side. I have filled these spaces by casting direct to the porcelain, and with the Logan crown I can do it very nicely with the Acolite, but whether that is going to stand I am not prepared to answer.

Dr. Muir: I think you can cast just as well on porcelain as any other way, but I do not think it is advisable. I do not think it is necessary. In the first place, it changes the color so much. I have cast some on porcelain and have never cracked a tooth, but they have all been experiments, as I have never done a practical case in that way. I think they are just as strong, and I think the tooth has more and better protection if the gold is cast on it than any other way. I do not see any necessity for checking a tooth while casting on it, but don't think it is desirable, because it is liable to change the color too much. I think it can be done just as well by cementing the facing after the casting is all complete.

I think I did have to grind the crown I am showing a little; I took just a little bit off the gold and ground the porcelain a little. There is some change due to a certain extent to the contraction of the gold. I do not think there is any machine made but that there is some contraction. In an inlay for a filling that can be taken care of by lapped margins and you can burnish it down so that you cannot detect the margin, but on a curved tooth as this is, you have to grind a little off to allow the facing to go into that gold. It may have been due to the shrinkage of the gold, and it may have been due to the distortion. I did it hurriedly because I wanted to get it ready to bring over tonight. I do not think that is any argument against the use of the method, because that tiny bit of grinding can be done with the articulating paper.

DR. A. W. DUMAS: I wish to speak in regard to the advisability of casting gold onto porcelain. I do not think any casting machine should take the credit of a successful casting of that kind; the credit should be given to the operator, who first heats his case and porcelain to the same degree of heat as the molten gold, because otherwise you have about the most powerful elements in nature, heat and cold, in contact, and unless you have your porcelain heated to the degree of your gold, you are sure to have trouble. I have been successful in many cases in casting upon bare porcelain, but I think it is folly to take such a chance. I think it is wiser to take a piece of pure gold and anneal it and burnish it over the tooth; in that way you save time and will not crack your porcelain. The cracking of the porcelain I think is due to the platinum pin in the tooth. I believe that as soon as the molten gold strikes these pins there is an expansion of the pins which causes a fracture in the tooth. You may take a Davis crown, and you can cast your metal, gold or Acolite upon it without removing, cast the whole at once, and the metal will find its place into the inside of that crown so that it will be impossible for you to take it out. From that I should infer that the cracking of the porcelain was due mostly to the expansion of the platinum pin baked into the tooth. I think it is economy of time and everything, to burnish a small amount of gold against your porcelain.

DR. MUIR: The credit should not be given to any machine for casting on the porcelain; it can be done with any machine. I do not advise anybody to do it. I say it can be done, but it is not desirable. If you will heat the case hot enough to get the porcelain so hot that the gold will not check it, it can be done in any machine. The facing has got to be hot for the same reason that when you cast on platinum or cast on gold plate, they have got to be hot so that the new gold will fuse onto them, and it will fuse onto them. This cast that I passed around has a platinum band. You cannot expect the hot metal to unite with a cold metal; the inside of the mold has got to be hot.

DR. C. H. LAND: I want to help you out a little on the casting. It is utterly impossible to fuse any kind of metal to a piece of porcelain. It was never known to happen. You can flow it over a piece of porcelain. Whenever a piece of porcelain and platinum come together, the difference between the shrinkage and the expansion of the porcelain causes the porcelain to crack from the stress on the pin. If you look at a piece of window glass upon which you see various designs, these are made by putting glue over the surface of a smooth piece of glass and allowing that glue to dry, and in doing so it rips out the design. You can never fuse onto a vitreous glass or porcelain a metal that it does not change the same; it simply rips off the design. It is far stronger to cement a crown onto a metal base than to fire it on. Every Logan crown is weak in that respect. Every bit of porcelain is fused in the mass; and from the piece of metal inclosed we will always have stress upon it, so that the tendency is to burst when it is re-heated. Cement your crowns instead of fusing them. If there is no strain upon a piece of porcelain it will stand indefinitely if you do not fire-crack it. If you fire a piece of porcelain on a metal base as in continuous gum work, it will change, carrying the metal plate with it; and the fractures are not enough to talk about; or it will peel off and leave a nice shining surface, and the thicker the metal the more it will fracture. To prevent fracture by the heat when soldering facings, before the gold is cold take a piece of asbestos fiber and cover the piece so that it cools slowly and it will not fracture. I have worked this hundreds of times and never had a fracture when I took that precaution.

DR. LEGRO: I do not think that the dentists have any intelligent understanding of what is going on when they are casting gold. They know that they are getting results but do not know what the cause of it is. They have not gone into the metallurgy of gold, or effect of pressure, and that is something that we have got to get an intelligent understanding of before we reduce this to an exact science or practice. As I stated, we have a great many articles published in the different dental journals, there is but one man who has written a scientific paper on this subject, and that is Dr. Price, of Cleveland. Of course, he is in a position to go into this scientific research more than the rest of us. I am rather disappointed, therefore, that it was not more discussed from the scientific aspect. However, I expected an "experience meeting," and such meetings always give us much to think about,

CAST GOLD CROWN

By C. E. Meerhoff, D.D.S., Chicago, Ill.

Especially adapted for bridge abutments. Trim root, fit band of 35 or 36 gauge platinum (or gold), stove pipe shape. Nip end of bands and bend over root. (Fig. 1.)

Have patient bite into wax, giving exact articulation. (Fig. II.)

Carve to correct shape and with bur or suction remove wax from inside as desired.

Pass quickly through alcohol or Bunsen flame, or rub down wax with chloroform to finish or smooth wax. (Fig. III.)

The crown on model has not been touched by buffer or wheel.

ADVANTAGES

Strength—Thickness of metal external to band makes crown unbreakable.

Definite seat—Ease of adaptation of thin metal obviating irritation at gingival.

CAST JOINTED LOGAN CROWN

By C. J. Burris, D.D.S., Washington, Ind.

The jointed Logan crown is by no means new, but is perhaps being used more since the advent of casting. It is especially advantageous in cases where from decay or otherwise the tooth structure has been lost to an extensive degree beneath the gum line.

After the tooth root has been prepared as in cases for the Logan, select a removable pin crown with due regard to size and shape and grind to a joint beneath the gum line on the labial surface only. Then by use of an iridio-platinum pin join the two parts with inlay wax and press to place against the tooth root. Remove and trim away the surplus wax, replace and burnish wax around the tooth root. The crown can now be separated from the pin and wax and the latter invested and cast preferably by the use of pure gold.

This method gives increased strength to the pin as well as the adaptation to the root surface; the parts can now be united with cement and when finished are ready for setting.

THE CAST GOLD INLAY

By James W. Lyons, D.D.S., Jackson, Mich.

It is a very great pleasure for me to appear before you at this meeting, one of the very auspicious occasions in the history of this society.

I am pleased to give you the best my feeble ability may permit on this subject which has interested the profession of the world and centered all eyes and thought upon an American dentist and an American city.

I may be unable to advance any new ideas, but I might present some thought in a light that some one may be benefited in the use of this method.

It is but just to give credit to those few constructive geniuses that are found in our profession. There is not a great number among those who have taken up dentistry as a life work to which we may point in either scientific or mechanical research who stand out pre-eminently above all their fellows, but our ranks are full of men, clean-cut, shrewd and wide awake to every progressive step forward made by the other fellow and are capable of applying the ideas and either simplifying or enlarging upon them, cutting and trimming away the corners, or rounding them out, thus making them all the more practical and useful.

It is true that many men's lives are so filled with work that they do not have the time to grasp and assimilate or even to try out the many valuable methods that are created for their benefit. We find a great many dentists who have long been accustomed to following out one specific plan in their work. They have, of course, learned by pursuing this plan, to do their work well and comfortably and rather dread to get out of the rut and accept anything in the way of an innovation.

A departure from the use of foil and the mallet and the adoption of the inlay requires much effort on the part of many dentists.

Two years ago I had the pleasure of presenting a paper on the gold inlay before this society. It is, indeed, remarkable, the progress made in these two years, and I greatly appreciate, when I read over the paper I prepared at that time, the importance the gold inlay has established among our many valuable filling materials.

ADVANCE BEING MADE

Do you comprehend the advance being made along mechanical and artistic lines by our careful and observing operators today?

To keep apace with the times, is there one thing that makes it more obligatory upon us than to get out and come in contact with the men who are doing things? When I meet and talk with a man who locks himself within his own surroundings his conversation upon dental topics has a like bearing to the knowledge possessed of current affairs by the man who never sees a daily paper.

The gold inlay came to us because within our minds there was a demand for just such an institution. We receive from mother nature many inventions at just such a time as when our surrounding conditions demand them. Our minds become imbued with the desire to accomplish some especial purpose and by concentrating thought along that line we develop that for which we are striving. At first our accomplishment may be crude, but by still further thought and by the application of scientific principles it is improved and made better.

Esthetic appearance brought to us the porcelain, which, be it beneficial or be it detrimental, our enthusiasts placed in all cavities regardless of location, but the more conservative man felt the need for a material which would better withstand the battering of mastication.

Manipulatory skill gained with the burnishers in burnishing the platinum matrices to the cavities developed the idea of thus shaping a matrix and flowing it full of the gold and employing it in large molar and bicuspid restorations, by such a material enhancing the value of our operation as to durability and overcoming the friable edge of porcelain. With this inlay of gold we had accomplished much, we had rendered inlay work more practical, and we had achieved much to better our services to our patient, but as we went along in the practice of these methods the only thing we seemed to be gaining was manipulation; we were learning to make closer adaptations, we were studying methods of producing the least amount of shrinkage, methods of procuring the hollow inlay and various peculiarities to obtain an ideal form to get the most perfect restoration of lost tooth structure.

When the time became ripe it was left to Dr. Wm. H. Taggart to bring before the profession probably the greatest achievement of the present century, "The cast gold inlay," and you wonder why *you* did not conceive of this system of producing the inlay, but as I have said before in this paper, we find the results of concentrated thought along this particular line. Dr. Taggart spent many weeks and months experimenting before he developed the proper idea of producing that which he sought. He had the completed product in his mind and was working to achieve that particular result with which he was crowned with success.

THE CAST INLAY

The cast inlay is certainly the highest ideal in the gold inlay. At one great stride Dr. Taggart placed all our matrix inlays so far in the background and out of date that they will never be resurrected. What an ideal method, when we can take a piece of wax and shape a wax filling in the mouth, restore occlusion and contour in its most minute form and then duplicate that in gold so that it fits the cavity, to absolute accuracy; it is most emphatically a great triumph in dentistry.

The method is but just in its infancy and yet its field seems unlimited. Almost every day presents some phase in practice in which we can apply the principle with the most remarkable and gratifying results.

Besides the inlay filling, it is admirably adapted to the restoring and building up of badly decayed roots for the purpose of crowning.

Ideal for anchorage of small bridges, repairing broken Logans, casting cusps, dummies and for a multitude of uses. Even if Uncle Sam would just guarantee us to keep out of the game we might even be able to retire from the practice of dentistry by casting gold dollars.

But, ladies and gentlemen, talk is cheap—just wait a bit. A few years ago we had men who couldn't find a cavity but what it came under the indications for a porcelain inlay. They even seemed to look upon, with scorn and contempt, the operator who, a little conservative, had evidence about his operating room that he had use for, sometimes, gold, tin and amalgam.

Today the conservative man has been wise, the other fellow is wiser; if he isn't, some one else has his patients.

We are even again hearing the same class of operators who always grasp a new method and ride it to death as a hobby, making the assertion that the day for mal-

leting in gold and for the old amalgam are gone, that they do not expect to make use of the malleted gold filling again.

It has always been a question with me, upon which I have not as yet passed decision, whether these men, faddists, if you please, are really a benefit or a detriment to our profession; my judgment is that they are at least enemies to themselves.

The cast inlay method is a great achievement in art and mechanics and I appeal to you all not to abuse it. By carrying out this method carefully it does for us what no other method ever accomplished to the same extent. Owing to the absolute accuracy which you *must* obtain, it develops in you, unconsciously, a high degree of skill.

Gentlemen, do not assume the idea that all that is required to make successful inlays is a particlular kind of machine. You have much to learn to become an inlay worker.

A gold filling thrown into the tooth most any way, providing you happen to have two opposing angles or pits, *may* stay long enough for the patient to move out of your locality, but an inlay inserted regardless of conditions stays a mighty short time.

The very highest art and skill are demanded in cavity preparation for inlays.

I believe a man will be able to do a very much better gold filling after he has done inlay work for a time, for the reason that his training in the thoroughness of his cavity preparation will instill into him the idea of very superior formation to what he has been accustomed to.

It has been suggested that the casting of fillings might have a tendency to cheapen our operations. Some men argue that as it is easier on them and does not take so long as to mallet in a filling, our fee should be less. For those men let me say, they should belong to the union labor crowd, where they could operate under a scale of wages.

It is too burdensome to my mind to work out a classification for such men among scientific and skillful dentists.

How unfortunate it is that our colleges cannot wake up to the fact that our profession needs fewer men, and *those* with high ideals, and not great numbers, who as failures in the highest arts in dentistry, might make the very best of machinists or blacksmiths.

This class of work should demand the closest application, plenty of time, and the best of your skill, all of which call for the best of fees.

It is a great mistake with the young men entering the profession in taking up the inlay as an easy method to a result, thinking, by so doing, of his abandoning the long, tiresome gold filling, when their experience has been so limited as to be unable to discriminate between the indication for filling or inlay. Their manipulation of filling materials is needed, their judgment and observation more mature.

You will find your patients very appreciative of a method which restores their broken down molars and bicuspids so excellently to usefulness, with so little inconvenience to themselves.

How much higher the ideal as compared with the gold crown which, at its best, is so ill-fitting around the gingivae which nature so admirably formed.

How perfectly the inlay replaces so many defective, unsightly and ofttimes poorly adapted amalgam fillings. While amalgam may have been both the patient's and dentist's friend in saving some pretty bad wrecks, yet like the untrue friend, it

has been the cause of many wrecks. I hope we may be able to eliminate some of these failures with the cast inlay.

I do not approve of the use of the gold inlay in the anterior teeth, excepting where great stress is brought to bear, as in end to end occlusion, or in opening the bite where abrasion has cut out the lingual surfaces of these teeth.

The work is very exacting and tedious, but because it can be done in stages it is not so laborious either to patient or operator as some of the older methods, and as far as my observations go, the end to be obtained is nearer reached than by the older method.

We are all amateurs yet in the handling of the cast gold inlay, and finding out every day that there are things yet to be learned which our conceit had attempted to make us believe we knew all about.

CAVITY FORMATION

The first step as with all inlay work is cavity formation, which, as I have said, calls forth all the skill and ingenuity that the best operators possess, if it is properly done. The plan of the cavity should first be mentally mapped out and then executed, if it takes the entire time for one sitting, because upon the proper and perfect forming of the cavity depends the success of the inlay. With the gold inlay it does not require the sacrificing of as much sound tooth structure as it may for the porcelain.

Force and direction of occlusion must be taken into consideration and the inlay set so that these forces have a tendency of forcing it into the cavity instead of out and away from it.

We must obliterate all undercuts that the wax may be drawn from the cavity without the slightest change of form. By slightly diverging walls, angles and beveled grooves, get all the frictional retention you can.

If possible to get, form your cavities wedge shape with flat base or bases bevel, converging towards the pulp.

The pulpal wall should be as parallel as possible to the surface of the tooth upon which the cavity is located. Saucer shaped cavities, with the dependence almost entirely upon the cement, will fail to hold an inlay for any great length of time, no matter how much time or work you may have put upon the inlay itself. Many discouraging failures in inlay work, I believe, are due to a lack of knowledge or disregard for these principles.

THE WAX INLAY

The next step is the wax inlay. I believe in taking a good generous piece of the prepared wax, for the reason that small portions are difficult to unite after they have been once moistened in the mouth. Soften the wax in warm water, not above 138° F. Do not apply dry heat as it seems to make the wax crumbly. Now press wax to place in the cavity, see that it presses closely to the bottom and over all the borders, then have the patient close the teeth and go through all the movements of mastication, as just the mere fact of shutting the teeth together does not give us correct occlusion.

The cavity needs no other lubricant than the existing moisture of the mouth.

After getting the correct occlusion of the teeth, I begin carving away surplus wax and also with flat burnisher work the wax down perfectly to and over all borders. Asking the patient to open the mouth, I hold the wax in place and carve and shape contours; then by means of cotton pledgets and tape moistened with liquid vaseline, I finish and polish this wax inlay until it is just as near my idea of what I desire in

the gold as I can get it. Very often I lift it from the cavity, chill in cold water, trim away feather edges and reset in cavity two or three times before I have it completely finished down. When I consider my wax inlay complete I remove and attach my little sprue wire. I prefer doing it this way to attaching sprue to wax in the cavity. Next, adjust sprue to the little crucible former and proceed to invest. This is another portion of the technique which is very critical and wherein your success hangs in the balance.

INVESTMENT

Your investment must be of such material in which the shrinkage and expansion shall be the minimum and not change form whatsoever under heat. It needs to be carefully and uniformly mixed and I have the habit of turning my plaster bowl on its sides and revolving while mixing until my investment is coated all over the inside of the bowl in a thin layer—thus allowing escape of any small air bubbles. Now, I prefer a small spatula to place the investment about the wax inlay, forcing a little investment ahead of the spatula and thus driving the air ahead and out of the corners and depressions in the wax. I build up investment about the wax until it is a thickness of probably a quarter of an inch all around. Now I place investment over all the inside wall of the flask and set by a twisting or rotating movement onto the crucible former and carefully proceed to fill it full with remainder of investment, not jarring it, as I wish not to liberate any of the amount of air still contained in the investment and by so jarring it would gather together this air and is very liable to collect on the wax model in little air bubbles, which, when your cast comes forth, you discover as little fine nodules of gold, which you wish were not there as it interferes with its being a *perfect* reproduction of your wax.

Now give the investment from fifteen to thirty minutes to set before applying slow heat to dry it out. When all moisture is gone and the wax has been absorbed and vaporized, place in machine, melt pellet of gold and cast. I aim to have the pellet of gold about three times the bulk of the inlay. The heat for melting the gold should be very intense and concentrated as with the nitrous oxide flame or the electric arc, as the gold should be in as fluid a state as mercury.

CASTING

The casting may be done by any of the machines now on the market, providing you can get absolute accuracy.

In experimenting with the different grades of gold to observe the contraction, I can but recommend that when you desire absolutely the best results, you must use pure gold. Dr. Price, of Cleveland, has done some very fine research work along this line, demonstrating both expansion and contraction of gold and its alloys, also expansion and contraction of our present investment materials, which you will find in the May, 1908, number of the *Items of Interest.* You may cast your inlay with the lower K. golds and get a result which to the operator who is not scrupulously observing might seem to be good, but when you examine for an absolutely perfect adaptation you find it deficient somewhere, owing to the contraction of the metal.

The casting of the hollow inlay has appealed to me because I always looked upon the hollow matrix inlay with favor, and employed it wherever the case permitted me to do so, consequently when taking up the casting I began trying different ideas to obtain the hollow cast inlay. The best method I have found, up to date, is a little copper bulb with a handle attached to one side of it and a small point a little larger than a needle attached to the other side, which is wrapped with absorbent

cotton or fibre asbestos; then by heating the bulb hot, enough heat passes into the point so that by touching the wax inlay where I desire the hollow part, the point will melt the wax and the absorbent draw the melted wax away, leaving just as much of a hollow portion as you desire.

The hollow inlay gives us a larger layer of cement just over the pulp and insulates it from the metal body and eliminates the thermal shock, as where we desire this inlay we usually have cavities which are in just such a location as to be particularly sensitive. They also give us more attachment for the cement which serves to increase the value of retention.

CEMENTING AND FINISHING

When our inlay has been formed and tried to the cavity and found to be perfectly satisfactory, set it with a very fine grained inlay cement and burnish all borders and polish, and if you are like me, you will at this time think of our grand old Professor Watling, when he said, in polishing the gold filling, give it the polish of the inside of your watch case.

SUMMARY

In summing up, let me say, first, make a study of the conditions, with your patient's benefits uppermost in your mind; use the cast inlay if in your judgment the restoration will be the very best that can be done by any known method; if not, then use that which *will* give such a result.

Do not insert the inlay until you are master of the cavity formation and know, *absolutely know*, that the cavity formed will hold it. Know that your wax inlay is as near perfect as you can mold it and get an absolute duplicate in the gold. Do not insert an imperfect inlay because you dislike to do it over again. Be a man and take the bitter with the sweet. Your patient will appreciate your interest in having your work right, but will despise you when she discovers you have deceived her by accepting your fee for a defective operation.

The measure of success we are to meet with lies in direct proportion to the care which we use in the preparation of our work. It is true to the same extent as with any other class of work; a man's individuality, his honesty of purpose, his character, his appreciative sense of his position in his chosen profession towards his services to humanity, are all distinctly shown.

If the operator is not willing to give time and study and research work in experimenting to bring this method under his control that he may better his services to his patients, I would advise him to let it alone. If the same operator is still unwilling to better his services to his patients along even the older methods at hand and still persists in staying in the same old rut at this day, it would be just as well for his patients if Divine Providence should conclude that his services were better needed in other fields.

That which I have desired most to impress upon you is thoroughness.

The dentist who is of the greatest value in his community is the one who is ever alert to every progressive step that will in any way benefit his patient. Such a man is elevating his profession, is making the best of the talents which have been given him, and lastly, doing the greatest amount of good for himself.

DISCUSSION

Dr. L. E. Custer, Dayton, O.: I cannot to any extent disagree with any of the points that have been brought out in this most kindly and excellent paper by Dr. Lyons, but rather wish to confirm some of the statements which he has made. I wish at the outset to pay a few words of tribute to

Dr. Taggart. We are prone to think of the cast inlay, or the invention of Dr. Taggart, as one not meriting what has already been said of it, because of its extreme simplicity. When a novice looks at a complicated machine, with all the levers, springs and wheels, he stands back in amazement and says to himself, "What a genius that man must have been who invented that." However, when a genius takes hold of such an appliance as that and has reduced the large number of springs, levers and wheels to a small number, to perform the same function, and has simplified an extremely complicated machine, to the thoughtful person that is the machine in which genius is displayed. The simpler machines are those in which the greater exercise of judgment and of patience has been used. And so I would say of the invention of Dr. Taggart, that we are prone, I think, not to give it the full measure of credit which is due this invention, because of its extreme simplicity—a simplicity which in the year and a half since its introduction has been the means of placing upon the market possibly fifty different methods of doing essentially the same thing; I say, it is such a simple thing at this date that we are liable not to give the full measure of credit to the man who worked out and who simplified this process.

Coming now to the paper, in speaking of cavity preparation, I think that we have had enough experience with inlays, both porcelain and gold, to know that the adhesive property of the cement is not the most effective thing in holding the filling in the cavity; that in just the proportion as we are able to so form the cavity that the filling will be held mechanically, keeping in mind the direction of stress of mastication, will the filling be retained, and it is a mistake on the part of any one beginning this work, who has not made inlays of either gold or porcelain, to trust much to the retentive property of the cement. We must, in some manner or other, form a dove-tail, and that can be done at the same time and the filling can be so shaped that it can be introduced as one plug of metal or porcelain.

The essayist spoke of inlays for the anterior teeth, and did not place much importance upon the value of cast inlays in this part of the mouth. I think that here is just as important a place as any other, and especially on the corner of an incisor where porcelain, by reason of its brittle characteristics, of which you are all familiar, cannot withstand the stress; here I believe that the Taggart inlay is the thing, but I would call to your attention the value of platinum combinations with gold, when the filling is used in this position. Platinum melts at about 3600° Fahrenheit, and you know that there are only two means by which that can be melted at present, the oxy-hydrogen blow-pipe and the electric arc. With the oxy-hydrogen we have enough heat to melt it in small quantities, but with the arc light we have 6,000 degrees of heat at our command and with this device it is possible to fuse pure platinum with proper investment material. We may make a pure platinum filling in this manner; however, it would call more especially for proper investment than for anything else, for withstanding so high a heat at the time of casting it would be better if we were to add some gold to the platinum—about three-fourths of gold and one-fourth platinum. It does not materially affect the color. I think the color is better than with pure platinum, so I would suggest the use of platinum and gold cast fillings for the incisors and any conspicuous fillings for the incisor corners and the anterior proximal bicuspid.

The doctor suggests the warming of the inlay and the wax impression material in water. I have felt from the first that the forming of it on a stick with a little sharpened point, and that heated over a flame to bring it to the right degree of softness, will give you a better impression of the cavity, because of the fact that the surface is quite soft and it is forced in every detail and line of the cavity on the inside by the harder material back of that. I rather lean towards that method of obtaining the impression of the cavity.

The doctor pays much attention to the wax filling. I think that this is just the thing to do, because at this stage, a few moments spent in the proper shaping and dressing of the wax fillings is time well spent and will save you much more time when it comes to the setting of the filling. I prefer to do this also for another reason, and that is that it is easier at the time of setting to burnish and thin the edge in closer apposition to the margin than it is in the unfinished or heavy margin of your filling. You have thus two advantages of dressing the wax beforehand, or if you fail to do that, trace your filling and get a close fit with the margin before setting.

In removing the wax filling I have always liked to warm the end of the sprue wire and imbedding that in the inlay it serves as a handle by which the filling can be easily removed. At the time of taking the wax out of the cavity you can feel whether or not you have prepared your cavity so that it can be properly drawn out, and if you have in any place a slight undercut, of course the enlarged part can be readily rubbed down so that it can be lifted from the cavity to be set again, then going over the margins for the last time. I have always been better satisfied with the melting in of the sprue wire than drawing or lifting the filling out of the cavity by the other method.

I think in our gold fillings we should use pure gold, because of the fact that it can be easily and readily burnished to fit the cavity margins. Never use a lower karat.

In addition to the notes which I have taken on the paper I would like to make a few suggestions which have come about through my own experience. Once in a great while an inlay will be made

that has not been sharply cast; it fits the cavity to the very corners but its margins are rounded instead of sharp. This being the case, it is an easy matter, if the margins are excessive, to set that filling and immediately afterwards go over the margins, turning an old carborundum wheel which has been filled with the grindings of gold, revolving that towards the margin, and you can push up the pure gold or flow it ahead of the wheel until you have a perfect adaptation. This can be done where the corners have not been filled out entirely. There are many faulty margins that can be made absolutely good in that way. If the filling is dry and the carborundum wheel is dry it is wonderful to what extent you can push the gold towards the margin by reason of the wonderful cohesiveness characteristic of pure gold.

Another point is this. In the proximal fillings there will always be noticed a point of contact with the neighboring teeth which is a little flat place right at that point. You can take a bit of 22 karat gold, about the size of a pin head, melt it on there, round it out, and it gives a rounded contact surface, to one which is usually either flat or concave. Sometimes these fillings are so well and closely adapted to the cavity that in a quite frail tooth you may chip off a little margin of the enamel. You need not make a new filling in this case. Heat the filling to redness under the blow-pipe and let cool without water, and place in the cavity a little bit of platinum and gold foil, or inlay platinum matrix material should be placed over the break. When the foil has been annealed it will cohere to the gold filling, and it can be formed in a moment to the enamel margin, and the filling may be removed and this little cup-shaped cavity can then be filled full of 22 gauge gold, and your filling will be as good as ever.

Dr. Muir, Detroit, Mich.: I want to congratulate Dr. Lyons upon his paper this evening. When I first started making gold inlays, I had lots of failures, and was just about totally disgusted with gold inlays, but now I have very good success. The dentists who use gold foil, and have always used it, cannot be blamed for not wanting to take to the gold inlay, but there are comparatively very few *good* gold fillings inserted. There is so much in favor of the gold inlay that I think every man should have an adequate inlay machine for making them. They must be used with discretion, of course. Those enthusiasts who have used porcelain indiscriminately, have some regrets, but it does not follow that everybody is going to take up the gold inlay and use it where it should not be used.

Dr. Taggart's paper, I think it was in the December issue of the *Dental Register*, gives a very concise and accurate method of each step of making the wax model. I got more from that than from anything that I ever read on the subject. The cavity must be prepared properly, and I like to heat the wax in water. Dry heat is all right if you do it properly, if you get it just exactly right, it will be all right, but it is easier to get it exactly right in water, and the water, of course, must be of the right temperature. After pressing wax into the cavity have the patient bite and cool it with a stream of cold water. Trim it off, and then smooth it with Three-in-One oil. There is something in that oil that dissolves the surface of the wax and gives you a perfectly smooth surface. In approximal cavities, use tape; put some Three-in-One oil on it, and run it in between the teeth, and it will give you a perfectly smooth surface there. Remove the inlay by the use of a fine copper sprue wire; heat it over the alcohol lamp, or gas; insert it into the filling with the right hand, holding in the left hand the water syringe filled with cold water, and when the sprue wire goes into the inlay, put stream of cold water on it. Remove the inlay by grasping wire with pliers. If it comes out hard, put it back again. If there is a slight undercut, it will burnish down. Before you take it out the last time, see that the margins are all right. After it is out, add a small drop of wax from spatula for contact point. Now take care in mixing your investment compound. Do not attempt to make gold inlays with a poor machine and with a poor investing compound. You must have good material to get good results. Carefully mix your investment compound. I mix it in a saucer. Don't get it too thick; spread it thoroughly over the saucer making a thin layer, and shake it well and blow on it, making the bubbles disappear that rise to the surface. They can be avoided by carefully mixing investment compound and applying same to the inlay with a camel's hair brush. After you have your inlay invested, take care of that. I learned this afternoon that men have had a lot of failures due to careless drying out You cannot hurry your investment in drying. I set it aside for an hour after mixing, and let it thoroughly harden. Then put it on a slow Bunsen burner or in an oven, something of uniform, steady heat, and gradually increase that heat, and I like to leave it there an hour until the moisture is well out of the investment compound, and there is no steam coming from it. Then you can give it as much heat as you like. If you attempt to melt your wax before the moisture is out of the plaster, the wax will bubble out of the cavity, and then you have a rough sediment on the inside of your cavity, and this spoils the inlay. In heating your investment, don't get your investment too hot. It is not necessary to get it hot enough to melt your cup; just get it hot enough to melt the wax. It will smoke a little while and your investment will be black. Apply blow-pipe until the bluish colored flame has entirely disappeared, and possibly

a little longer. It is only necessary to burn out all the wax, and further heating does not do the investment any good. You cannot get satisfactory results for an inlay with any other gold but pure gold. 22 karat will not do. I like to try the inlay in, as soon as I have it cast, and cut the sprue off. If it goes to its place nicely, take it out and polish it with sand paper disc, and with the grinding surface of a molar, you will have to cut down in there probably with a fine bur—a very small plug finishing bur, or a No. ½ or a No. 1 bur for the fissures. A dull one does the work very nicely; and then burnish. Put the inlay in the cavity, and before setting, thoroughly burnish it around the margin. I do not like to burnish after setting. You must burnish before the cement thoroughly sets. Unless it fits into a wedge-shaped cavity very tightly, you are liable to move it, and if you burnish it before cementing, you do not have very much, if any, burnishing to do after. Polish it with sand paper discs, or fine stones rotated on the margins from the inlay towards the tooth. Finish with pumice.

Dr. W. L. Williams, Sault Ste. Marie: I have had very little experience in cast gold inlays, and I am here to learn, and I think we ought all to honor the pioneers of this work. It is those men whose names will go down in history, and as I am not a pioneer, I honor the gentleman who read the paper, and my friend, Dr. Custer, and will beg to be excused from saying anything more.

Dr. Travis, Plymouth: The paper has been so ably written and so well discussed up to the present time that while there may be a great deal that could be said upon this subject, yet, it seems to me, that there is very little that we could say tonight that would add very much to what has already been said. However, we all know that the gold inlay of the cast variety has been a blessing to the profession and to our patients, and that it will be received by both alike as a blessing. We know, too, that it possesses qualities that no other filling possesses. We obtain by this method a strengthening of the walls, and a more perfect sealing of the cavity, and at the same time we obtain a non-conductor. There are a great many cavities that we have to deal with where it would not be wise for us to use the gold inlay; however, up to the present time there seems to be nothing equal to it in other cavities, and it seems that a great many of us are led at this time to use the gold inlay in cases where it is not indicated. C. N. Johnson, who has been one of the greatest advocates of the gold foil filling, is now one of the strongest advocates of the gold inlay, and yet he has said that if the inlay had been used for forty years or more as the foil filling has been, and we were now to introduce the foil filling, that we would be just as likely to go into ecstasy over the use of the foil filling as we are now over the inlay. The methods of producing this inlay by various instruments is something that I am not very familiar with, but in the clinics that I have witnessed it appears to me that a great many, in demonstrating this, have been satisfied by submitting to us samples that are a long ways from perfect, and they always do that with the apology that this is merely a clinic and that it has been done hastily; that it approximately fills the cavity, and that you see the principle, and now if you will only give it time that you can produce perfect results and get perfect borders; but only in very few cases we find that they can with uniformity get these perfect borders. I believe, as a member of the profession—and most of us believe the same way—that it is not the price of the instrument with which we are to attain these results that determines our choice, but rather that we may be positive that with this instrument we shall be able, uniformly, to secure perfect borders. What I mean by perfect borders would be a border sufficiently perfect that we could burnish over and get a perfectly tight border, and protect the cement so that none could tell it from the gold foil filling.

Dr. J. W. Lyons: The discussion of the paper has not been agreeable to me in a way I would like to have it. In preparing this paper I hoped to get a great many pointers myself in the discussion of it, from other men, because I feel that there are many things yet to be learned about the cast inlay; it is not nearly perfect, by any means, and there are a great many things to be developed yet.

Dr. Custer thought I did not lay stress enough upon the use of the cast inlay in the anterior teeth. I do not like to use the gold if we can get away from it wherever it is possible to use porcelain, and I think it is possible by proper methods. I like to see the porcelain inlay used in the anterior teeth. but where great stress is brought to bear upon it, and where it is impossible to hold it, then I would resort to the gold inlay, because, without regard to my own feelings as to ideal methods, in my own mind I feel that the patient's benefits are the first thing to be considered. Durability has much to do with the building up of a practice and the building up of your reputation. If you insert fillings or inlays and they have to be restored in a very short time, you lose the respect of your patient; you cannot hope to hold the respect of your patients in having work fail; although you may desire to have a porcelain stay in place, thinking that it is much more esthetic than the unsightly gold, yet your patient will think more of you if your work stands.

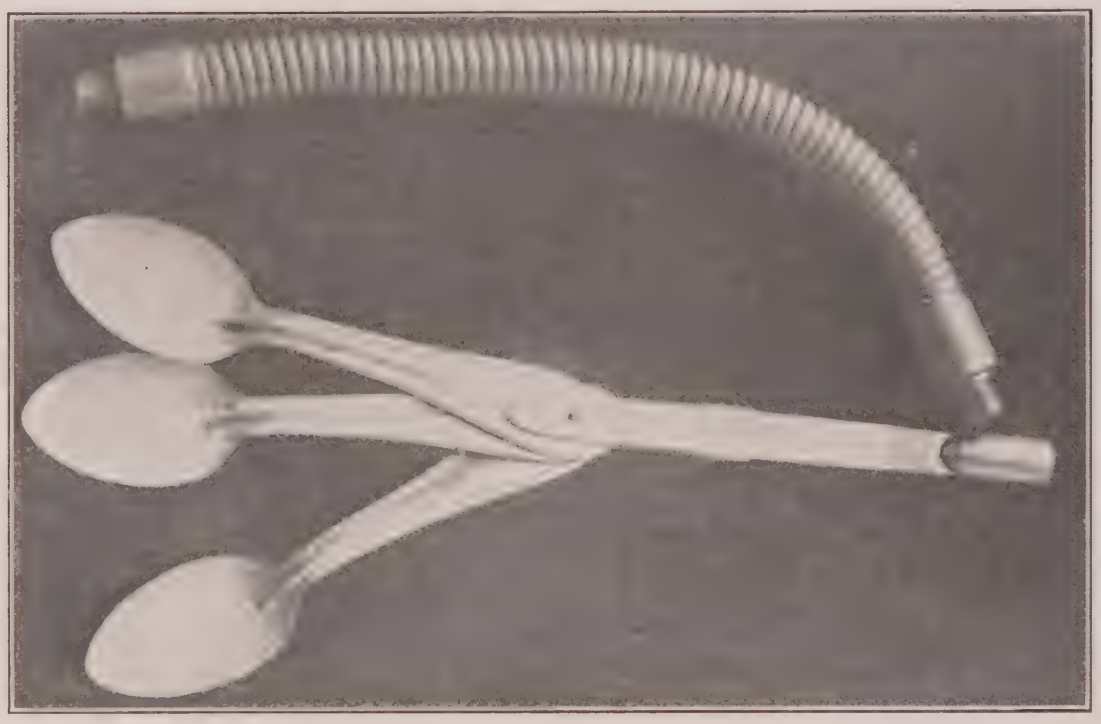
I thank Dr. Custer very much for the added suggestions that he has given us, and the gentleman here on my right, because I know from his talk that he has been up against a great many of the same things that I have been.

A SOLDERING DEVICE

By Dr. T. B. MaGill, Kansas City, Mo.

Screw the flexible arm on to the crown foot, then screw on the clamp-pliers; open pliers and insert the iron spoon (one or more). The pin in the pliers to go through the holes in the spoons.

Now any soldering which has to be invested can be invested in the bowl of the spoon. (Crown or Bridge.) Coarse investment is better as it is not so apt to blow up by heating too rapidly.



A soldering device, by T. B. MaGill

After case is invested the flexible arm can be adjusted high above a Bunsen flame and as it heats up bend down into flame. Use a very small amount of investment, a film 1-16 in. thick is plenty, the spoon holds it in shape, also distributes heat evenly.

To solder, place an empty spoon in pliers with one holding invested case. Place the solder in empty spoon. Another spoon may be adjusted for another karat solder or flux. Apply heat from beneath until case is cherry red, then apply solder and flame. By using flexible arm you can get to any part of investment with blow-pipe.

CASTING: A RETROSPECT

By Dr. J. G. Lane, Philadelphia

When it first became known that certain areas in Alaska were rich in gold, ravenous prospectors and claim-stakers jostled with and fought each other in their mad rush over the coveted territory. This proceeding was carried on amid such a degree of excitement,—each person fearing that each and every other person might find something better than he himself—that the entire field was sort of wallowed over, and worked too superficially to find out what conditions really did exist. After the place was thus imperfectly worked out in the first spasm of excitement, the same ground was again covered in a manner that was sane and sensible enough to unearth the real value of the environment. These same conditions obtain in our profession as often as new or novel procedures and methods are sprung upon us. And the more unique and novel the innovation, the more this condition obtains. In this particular, casting has been an exception only in that it has been the most extreme case of this kind that has ever come within our observation. And now that the first grand rush for supremacy and record is on the wane, it is high time that we begin to look back over the field, take a retrospect view of what has been done, the theories and methods advanced, and to sift the real wheat from the chaff. This sifting and winnowing is likely to send many pet theories and ideas to the wind—never to return; and indeed wisely so. The dental journals,—aye, and even textbooks on the subject in question, —tell us all manner of theory and methods in the art; many of these are so unreasonable, fallacious and unscientific in their very aspect, that we cannot but assume that the exponent of such has in all probability arrived at his conclusion theoretically, rather than scientifically or clinically. While we know that the profession as a whole has been wondrously benefited by the result of all this effort, yet we cannot believe other than that many things which have been written and said on this subject from time to time, have proved to be an injury to the cause rather than a help.

Quoting Dr. C. S. Van Horn, *Dental Cosmos*, Vol. LI, p. 549:—"At present our work in this field is largely empirical; we have not practised casting sufficiently long to have established it on a scientific basis; consequently we are too many times between the devil and the azure brine to know the how and the why. Some day the clouds will roll away." And in accordance with this thought, we think it high time that some of the overhanging clouds should roll.

The purpose of this paper, therefore, will be to point out some of the extremely opposite views that have been taken by various experimenters, who, by experiments conducted technically, theoretically, scientifically, and clinically, have endeavored to reduce the art of casting to a true and proper basis.

Let us consider the impression method for inlay work as advocated by Dr. Weston A. Price, *Items of Interest*, Vol. XXX, p. 363 and 938, and by various other inlay workers. This method has adherents both in the clinic and in literature; the usual arguments advanced in its favor being the lessened possibility of distortion of an impression as compared to a possibility of the same in a finished pattern while being removed from the teeth or cavity; time saved at the chair and less annoyance to the patient. Let us quote your essayist from the *Dental*

Digest, Vol. XV, p. 436—"The pattern for a gold inlay should be made in the cavity that is to receive the finished casting. This insures a better adaptation than can be had by any method thus far devised for making the pattern in a model. In the former method we have three transfers—cavity to pattern, pattern to investment, and investment to gold. In the latter we have five transfers—cavity to impression, impression to model, model to pattern, pattern to investment, and investment to gold; or, if the casting is done directly in the model we still have four transfers by the latter method. In any transfer we can scarcely avoid losing detail and definition; therefore, the fewer the transfers the better the inlay is going to fit,—all other things being equal. Furthermore, there is vastly more possibility of distortion in an impression than in a pattern. This can easily be understood when we consider that the pattern is adapted to the interior of the cavity only; while an impression for a model is adapted not only to the interior of the cavity but also to the exterior of the tooth—as well as to adjoining teeth. Removal of such an impression from the tooth or teeth is almost sure to distort it; nor is there by this method any possibility of determining whether distortion is present or not until the inlay is made. By the direct method there is very little possibility of distortion; or if there is a suspicion that distortion is present, it can easily be proven and corrected before proceeding further." Instead of the impression method amounting to a saving of time in the chair, we believe it to take more time than the pattern method, because of the fact that two operations—one for impression and another for bite—are necessary. And if, therefore, as much time is consumed, the patient has not received the benefit of any spared annoyance. If, as is advocated by some, the model for such a case is to be made of amalgam, and the wax pattern for the inlay then made in the amalgam model, we at once find that the time consumed after the impression and bite have been taken, is very prohibitory—in addition to the almost certain result of inaccuracy on account of too many transfers, and the possibility of distortion. It is, therefore, patent to all that the method which will insure the greatest accuracy of adaptation is the one which is most desirable to follow.

We believe that the more general use of inlays has done much toward educating the profession in general to appreciate a higher standard of cavity preparation. As to fundamental conditions which should obtain in this part of the work, all seem to be pretty nearly a unit. In detail, however, there are wide differences. Let us quote Dr. P. B. McCoullough, *Dental Cosmos*, Vol. LI, p. 1175:—"No filling material has at its square edge the strength of the square edge of enamel. The beveling of enamel margins for protection is illogical when the weaker body is to provide the protection." Let us also quote Dr. Theodore C. Trigger, "Notes and Methods of Filling Teeth with Gold Inlays," p. 46—"The marginal edges of the cavity should be cut straight and beveling avoided." The authority quoted repeats this statement on p. 59 of the same publication. Let us also quote your essayist, *Dental Cosmos*, Vol. LI, p. 434—"The margin of a gold inlay being thoroughly homogeneous is reliable even at an angle of 65 degrees. This secures for the enamel margin the remarkably strong angle of 115 degrees." This seems to be just about the extreme opposite. However, we feel positive that we have seen our contention in this upheld clinically at all times; and we believe that proper clinical results are most important. For inlay work we disapprove of the extremely angular form of cavity preparation generally known as the "Black Method," and by some inlay workers followed out in cavity preparation for inlays. We believe that the inverted cone and square end fissure burs have no place in the equipment for inlay cavity preparation. Quoting

again from your essayist, *Dental Cosmos*, Vol. LI, p. 433:—"Sharp angles at the cervico-buccal and lingual aspects of an approximo-occlusal cavity have no point of merit whatever, and serve only to weaken the tooth as a whole." Also quoting Dr. Trigger from the publication mentioned above, p. 59:—"The enamel walls should not terminate too abruptly in short curvatures." P. 60:—"No definite angles are used in the preparation of cavities for inlays." And further down the page, "At the junction of the gingivo-labial and buccal surfaces the cavity should be cut in a rounded form." Dr. Trigger then goes on to state the advisability, and almost necessity, of sharp angular forms in these parts of cavity preparation for gold foil fillings.

Sharp angles at the points mentioned in the quotation of your essayist, have the effect of confining the area of possible fracture to *one* point, while if these parts of the cavity have a very slightly rounding effect the area of possible fracture is distributed over the area thus filled in, and *no one* point will have to endure the entire violence, e. g., a steel bar 3 inches in diameter, having a point at its center cut down by a narrow sharp edged groove to 1 inch diameter will fracture more readily under load than if the entire bar (or even a longer distance in its center) were only 1 inch diameter. If there are sharp angles pointing outward from the interior of a cavity there will be similar angles in a casting mould; these are likely to receive slight abrasion and injury when the gold is cast past and against them, thus causing a misfit. The more angular the cavity the more difficulty is experienced in getting the inlay properly seated; the surplus cement must follow a more tortuous line to escape. We cannot see that sharp internal angles add in any way whatever to the degree of stability or fixation of an inlay after it is cemented in position; nor can we see how such could in any possible manner strengthen the operation and tooth as a whole. Furthermore, there is a possible element of inaccuracy of adaptation to sharp angles in making the wax pattern.

Much diversity of opinion exists in regard to the temperature the mould should have at the moment of casting. Quoting Dr. Marcus L. Ward, *Dental Cosmos*, Vol. LI, p. 1055:—"We are to cast our gold into moulds which have been heated sufficiently to eliminate all mechanical moisture and allowed to cool down till they can just be handled with the hands without discomfort if we are to place the casting of gold on a practical as well as scientific basis*." Quoting also Dr. C. R. Baker, *Dental Review*, Vol. XXIV, p. 133—"My first conclusion is,—that the only way to cast inlays is in a cold mould. . . . With a cold mould we get a better specific gravity." Quoting also your essayist, *Dental Digest*, Vol. XV, p. 499—"If the flask contains a mould of an inlay for a double compound cavity, or one that encircles or sits astride some portion of the tooth, it should be exceedingly hot at the moment of casting. This will give the minimum of shrinkage with a given investment." And on the following page—"For inlays representing simple interiors, the flask need not be so hot as for the classes just described; but it must always be borne in mind that the lower the temperature of the flask the greater the shrinkage, and that the approximate amount of shrinkage desired shall determine the reduction of temperature in the flask at the time of casting."

Dr. Ward, in the publication quoted, does not seem to give any very definite reason for his belief regarding the temperature of the mould. Dr. Baker states his reason as being that a better specific gravity is obtained. We cannot see that Dr. Baker's figures for shrinkage (or expansion) in the publication quoted (pp. 130 and

*We are not informed as to just what this scientific basis is.

131), mean very much unless the size of the pattern for each was given. On the following page we may read:—"The average size of the wax cubes is .1995 in." Unless the patterns had an absolutely uniform and stated size the table would not show much, except by computation if the size of the pattern for each experiment was given. The sizes are not given except as above. Experiment No. 3, Table III, reads:—"5 dwt. hot .2000, 18.308 Pecks," and conveys to us the information that 5 dwt. of pure gold was cast into a hot mould of Peck's investment, and that the resultant casting measured .2000 in. and had a specific gravity of 18.308. No figures are given for the size of the pattern for this particular casting. But if the flasked pattern was .1995 in. we believe that the result as stated is a physical impossibility so far as it pertains to the size of the casting. Experiments that we conducted along this same line to determine figures on shrinkage showed Peck's investment to have a very decided degree of contraction on being heated to a high temperature. Our figures for the particular experiment that might be placed in comparison with the above are these:—size of pattern .5000 in. (half an inch); temperature of mould,—red heat; size of casting,—.4957 in.; investment, Peck's. This shows a loss of .0043 in. in a casting made in a mould as hot as the fusing point of the brass flask that contained the mould would safely allow. In eleven of the twenty-eight experiments of Dr. Baker we are given figures which show castings larger than the pattern (.1995 in.) anywhere up to .2030 in.—or in one instance an increase of .0035 in., and this in a vacuum machine. Two of the tables given are the data for vacuum machines. The make of vacuum machine is not given, but we assume that it has iron flasks. Iron has an expansion equal to about one-half the expansion of gold; and in order to expand enough to give a casting the size of a given flasked pattern would have to be heated to double the fusing temperature of gold. Of course, the investment would not stand this; and granting that it did, the casting would show a register only after the whole had cooled down to 2016 degrees—which register would be only half enough to neutralize the contraction of the gold. In our experiments the best result obtained in an iron flask, cast at red heat, gave a casting .4943 in. from a pattern of .5000 in. Two other machines mentioned in the tables are Taggarts and Jamesons. These both have brass flasks. Brass expands a trifle more than gold at a given temperature. With these it is possible to get a casting almost the size of the flasked pattern, but absolutely no larger. The highest reading we obtained on castings made in a brass flask, and at a temperature almost sufficient to fuse the flask, was .4992 in. from a pattern of .5000 in. We are strongly of the opinion that Dr. Baker's patterns were not the size he supposed them to be.

Increased specific gravity is, indeed, a most excellent feature in an inlay. And we do not take issue with anyone's statement that casting in a cold mold increases the specific gravity of the casting thus produced. We have not experimented along this line but we know that this condition obtains in grey iron. Grey iron cast against, or in, "chills," is so finely crystalized and hard that it cannot be cut except by grinding; and cannot be annealed except by remelting. If, however, the increased specific gravity of a gold inlay be obtained at the expense of accuracy, of adaptation —which feature would undoubtedly obtain from shrinkage if cast in a cold mold— we cannot but see that as a whole an already strong point has been strengthened, and a weak point made weaker. Namely, the density of any gold inlay is more durable than the cement line which surrounds the inlay. Increased specific gravity can be obtained to a sufficient depth on the masticating surface by means of round or corrugated engine burnishers,

Quoting again from Dr. Baker, in the article previously referred to, "If we have a step cavity with a good dovetail in the occlusal we find that that dovetail is going to draw the inlay into position towards the occlusal in such a way that when pressed down or hammered into place in the best possible way there will be at the cervical a heavy line of cement showing. Why is that? It is simply because the cavity is prepared with almost parallel sides, and if this inlay is the same size as the cavity, the cement will take up too much space, so that it raises it." Our observations in such instances have shown that the condition as described is not due to its close fit in the cavity and the interference of cement, but because of excessive contraction of the inlay. When the morsal part of such an inlay is seated on its foundation, the approximal part is not long enough to reach its destination at the cervical aspect of the cavity. Also that the part fitting into the dovetail (if this dovetail be a very pronounced one) is so contracted that it will not allow the approximal part to fit closely against the pulpal wall of the cavity except at the angle of the step. This observation may easily be made, and the facts cited determined, by placing such an inlay in the cavity *without* cement, and see exactly the condition referred to.

We believe that the shrinkage problem in cast gold inlays is not generally considered as important as its clinical results will warrant. Quoting from Dr. Ward, *Dental Cosmos*, Vol. LI, p. 1056: "If, then, a filling 1-4 in. in diameter shrinks .0008 in. and is seated in the center of the cavity, there will be .0004 in. to be filled with cement on each side. If the casting be a compound approximal one for a molar measuring 1-2 in., we can only calculate a total shortening mesio-distally of .0016 in. Imagine, if you will, such a cavity being prepared with its walls inclining sufficiently to enable one to draw a wax impression, and a filling that had shortened from the extreme ends only .0016 in. Do you doubt its going to place? It will do it so closely that the naked eye cannot detect it, if the cavity has been properly prepared. These figures will not hold good for casts made in a red-hot mold, or if the gold is superheated. They hold good for casts made of gold heated above its melting point, and a little below its boiling point, and cast in a cool mold." Also quoting Dr. Price, *Items of Interest*, Vol. XXX, p. 933: "In bridge work, because of the length of the piece, the cooling contraction not only makes the piece too short to reach the abutments, thereby throwing one of them out of register, but, if the attachment encloses a foundation as a ferrule for a root, its decreased diameter will not allow it to go over." In *Dental Cosmos*, Vol. L, p. 940, (Hinman) shows a cut of a bridge with two inlay anchorages. *Items of Interest*, Vol. XXXI, p. 815 (Reynolds), shows a cut of a similar bridge. Dr. Baker in the article referred to a number of times, says: "1-10000 in. in the size of an inlay larger than the cavity is almost fatal." In the bridges referred to, a shrinkage of 18-100 of one per cent. would put the inlay anchorages so much out of register that they would not seat properly, and possibly not even indifferently. The double compound inlay that registers a shrinkage of .0016 in.—as cited by Dr. Ward in the above quotation—would certainly not go into place unless it was forced into the cavity under a pressure sufficient to actually stretch it. This particular kind of inlay is the most difficult we have to make; and one wherein the shrinkage problem looms up most forcibly. For if the inlay is large enough to nicely sit astride the shallower central part of such a cavity without stretching, it would have to be at least as large as the cavity. If such an inlay is absolutely as large as the cavity it will not go in and seat properly for the other dimensions; and particularly so when we reckon the space necessary for the cement line. One dimension of such an inlay ought to be a trifle larger than the pattern; and the other dimension

shorter. This condition we know would be impossible to obtain; and the only chance for us is to force enough stretch into it to allow it to reach over the interior of such a cavity.

We are firmly of the opinion that the investment has a very great deal to do with shrinkage, or lack of the same. An investment material should expand sufficiently on heating to follow up the expansion of the brass flask which contains it. With such an investment the shrinkage can easily be taken care of, except in large bridge castings. During the autumn of '07 your essayist conducted a more or less exhaustive series of experiments in an effort to formulate a suitable investment compound. The result of the experiments was given at a regular meeting of the Pennsylvania Association of Dental Surgeons, during the same autumn, and also in a paper read at San Francisco in June, '08:—a record of which is in the *Pacific Gazette*, Vol. XVI, p. 586. The best results we obtained were gotten in a compound made up of cast plaster 1 part, and very finely powdered silex 3 parts (by weight). In April and May, '09, we conducted a series of experiments to obtain data on shrinkage of gold castings. Castings made in Peck's investment compound showed 83 - 100 of one per cent. shrinkage; S. S. White's showed 18 - 100 of one per cent., and in silex and plaster as above given, we had only 16-100 of one per cent. shrinkage. These figures are for casts made in hot molds. With the same investments and technique, except that the flasks were allowed to cool to a temperature which allowed handling with the fingers, we had a loss of 1.64 per cent. by shrinkage in the plaster and silex investment, and proportionately more with the other investments mentioned.

Quoting from your essayist, *Pacific Gazette*, Vol. XVI, p. 589: "A smoother casting is obtained if the investment has been allowed to remain some hours, or even days, before heat is applied." While this idea is all right for the purpose stated we find that if a flask is allowed to stand a long time before casting we have a marked increase in the shrinkage of the casting made in such a mold. We, therefore, find it advisable to choose the least evil, and cast within a few hours, at most, after investing.

We, with others, believe that the time will come when the perfection of casting devices will make it possible for us to pre-determine the amount of shrinkage. Quoting Dr. Baker, *Dental Review*, Vol. XXIV, p. 130: "I believe that the time will come when we can control the size of the cast we want by the temperature of our investment. When we get this work down to a certain point we will need a thermostat to tell the temperature of our investment when we cast in order to get the size we want." Quoting your essayist, *Dental Digest*, Vol. XV, p. 499: "It yet remains for some genius to devise a form of casting apparatus with a pyrometer attachment to indicate the temperature of the flask while casting; this, in conjunction with an investment material of known physical properties could be a means of accurately determining the relative size of the casting."

We believe that a misconception is more or less generally extant in regard to why any pressure should be needed to place and hold the molten gold in the mold in casting, the commonly accepted idea being that the pressure used is needed because of air and gases within the mold. Quoting Dr. Trigger, *Dental Brief*, July, '09, p. 469: "In order to force the molten gold into such a mold already described it requires a pressure exerted on the metal in the molten state to overcome the atmospheric pressure of air within the mold, that is, the force on the gold must more than equalize the air within to allow it to flow readily to all parts." According to experiments which we conducted we believe that air or gas resistance has so little

to do with the need of pressure that it need not be taken into consideration. Quoting your essayist from the *Dental Digest*, Vol. XV, p. 498: "The only reason why any pressure is needed is that the molecular attraction that holds a mass of molten gold in globular or spheroidal form is greater than the force of gravity; the gold, therefore, will not by force of gravity change its spheroidal form and flow down into a mold without assistance." The experiment which proved this consisted in preparing a flask with investment material in such a manner that the sprue opening extended entirely through the bottom of the investment and flask. The flask was heated to redness—as if for casting—placed on a support so arranged that anything that wanted to go through the sprue opening would have no interference from within or underneath, and gold fused in the crucible. There was, indeed, under such conditions no air resistance from within or underneath; but gold fused in the crucible immediately over the sprue did not drop through the opening. Varying amounts of gold were tried: 2, 3½ and 5½ dwt. The first sprue opening tried was of standard size for practical work—.055, or a trifle smaller than 15 gauge. The gold was heated by the oxy-hydrogen blow-pipe until volatilization began. If the flask was raised a couple of inches and set down with a jolt the gold would then run through. The size of the sprue opening was increased by known stages until it was .120 in. (almost 1-8 of an inch) before the gold would run down of its own accord when melted—and even then only when heated to a temperature quite beyond its fusing point.

We believe that the margins of an inlay should be thoroughly burnished to the cavity margins as soon as cemented in, and before the cement has become friable. And in order that the burnishing may be effective as a means to an end, the wax pattern must have been prepared without any overlap whatever. If an overlap is present, it is the overlapping part that receives the burnishing, and which is afterward cut away in the finishing. What is then the edge of the inlay has not been affected by burnishing at all.

The cementing and finishing of an inlay should be completed at the same sitting, and before the cement has attained its utmost density. We believe that it is possible for the heat caused by the friction of grinding stones to be in some cases sufficient to cause expansion of the parts involved; the inlay having a very different coefficient of expansion from that of the cement and tooth under it may cause some areas to actually break the heterogeneous union. Before the cement has become fully hardened its physical properties would allow for this unequal expansion without risk of fracture. This, purely theoretical, having no data on the subject; but we believe that it is possible for this condition to obtain. As stated earlier in this paper, the desired specific gravity on the surface may be obtained by the generous use of engine burnishers of steel or agate, or still better, of corrugated steel.

After noting the vast differences of opinion that we have quoted and referred to, we may in our perplexity well wonder, as did Pape in his "Moral Essays"—"Who shall decide when doctors disagree?"

DISCUSSION

Dr. E. B. Lodge, Cleveland, O.: I will take this opportunity first to thank the program committee for allowing my name to appear in connection with that of our essayist, Dr. Lane.

The subject is a most timely one and one which must elicit the attention of all dentists desirous of attaining the best results for their patients. In much that the essayist has said I most heartily agree, but there are some things which I cannot indorse.

Quoting from the essayist's paper, he says, "In any transfer we can scarcely avoid losing detail and definition, therefore the fewer the transfers the better the inlay is going to fit, all other things being equal,"

Now, there are none who will not agree to this statement, as in it the essayist is perfectly right, but he tells us "the pattern for a gold inlay should be made in the cavity that is to receive the finished casting, that it involves but three transfers, cavity to pattern, pattern to investment, and investment to gold." The model method where, for example, we have an amalgam model, he tells us that we have five transfers, "cavity to impression, impression to model, model to pattern, pattern to investment, and investment to gold," and again to quote, "or if the casting is done directly in the model, we still have four transfers by the latter method."

Just here I must object; since the model made in the impression becomes a part of the investment, how can it entail another transfer of cavity surfaces than when a wax pattern is invested? Dr. Lane is in error, for each process entails only three transfers of cavity surface Then, too, in securing the occlusal dimensions the patient can close his teeth upon a piece of softened wax as readily as he can close upon a wax pattern within the cavity.

Few operators can carve a wax pattern for a compound cavity within the mouth in even ten times the time required to carve a very accurate one upon a stone model of the case, by which method is avoided the almost impossible task of carving exact contours and margins under the gingival tissue in a difficult environment.

This method obviates also the possibility of the wax pattern lifting up at one side when pressed down upon the opposite side as is so liable to happen in the direct method. I should like to ask further how the essayist would get the needed pressure on his contact point without extra work

How by the direct method can an operator reproduce several contact points at once or even two adjoining and get them accurate? (Here I show set of models, one showing inlays with five contact points and two double compound cavities.) Just figure the difference in time carving them all up in the cavities and taking one impression of them all in a few seconds. Can any man produce as perfect contours by carving in the wet mouth as the finished model shows? All those restorations were inserted together.

How does the essayist hold the inlay in polishing? How, in polishing, does he prevent spinning of the margins? How, too, does he prevent the gold from shortening mesio-distally in a double compound cavity, and how does he correct for distortion of the cavity surface due to pressure upon the investment?

And how is he able to differentiate between expansion, distortion of the investment and expansion of the cooling gold or decrease of normal contraction due to pressure exerted?

That a distortion does result from the pressure exerted upon the investment from within at the time of casting is a demonstrable fact. This is overcome by the use of the artificial stone model. Its rigidity enables it to withstand any amount of pressure that may be desired without distortion and consequent change of shape of the resulting inlay.

One point further in the advocacy of the model method, greater accuracy of adaptation is assured, particularly in compound and double compound cavities, by the taking of an impression in a suitable wax and specially adapted tray to hold same, and I believe there is less likelihood of distortion in the removal from the teeth of such a tray with its wax impression than there would be in removing a wax pattern directly from such a cavity.

Dr. Price has shown and I will quote his exact words, "the total contraction of a definite part of cooling mass of any metal or alloy can be materially lessened by the application of pressure to another part of the same cooling mass. This causes most of the contraction to occur in one place where not objectionable. As the contraction takes place the mass is moved by the pressure at a certain point to replace the shrinkage taking place elsewhere, but this can only occur so long as the pressure is greater than the resisting strength of the mass, which for available pressure for our use is only a few hundred degrees."

"By this means we can with only one-fiftieth of an ounce actual pressure reduce the total contraction in part of a mass of pure gold from 22.5 thousandths to 20.5 thousandths and with one-tenth ounces reduce it to 18 thousandths. With three pounds we may reduce it to 14 thousandths and with five and one-half pounds to 13 thousandths. Remember that the actual pressure is not represented by the surface pressure per square inch of a gas pressing upon it."

To quote still further, "The other methods of correcting this contraction are by modifying the alloy to have a minimum contraction (in which as yet but little has been done but no doubt will be) and by either enlarging the mold so that the cast will be the correct size when contracted, or by holding the metal, compelling it to stretch when cooling, or both. This can be accomplished by expanding the mold into which the cast will be made, and the latter only where the metal can be confined over a very strong form, as a ring around a very hard core.

"The expansion of the mold has been accomplished to a certain but not sufficient extent by heating an investment material forming a mold and casting into it when hot. The best of these only allow an expansion by this method of six or eight thousandths, and most investment materials very much less

if not an actual contraction on heating and this class of material on heating being chiefly silica and plaster, has so little resistance or strength that it is easily distorted by high pressure, absolutely limiting the use of the first named method for preventing the contraction, viz., by making high pressure on another part of the cooling mass, for they yield producing beads and distortion on the surfaces, which if on the cavity surfaces of the inlay, spoil it. The ideal conditions demand, then, that into the mold into which we cast, all surfaces that are to make contact with cavity walls and margins be so hard and strong that they will allow of high pressure without yielding and should expand either when heated or setting, or both, to increase its dimensions uniformly about 15 thousandths which is one and one-half per cent.

"When casting upon this with an actual pressure of about two and one-half pounds, we will have a cast within about one thousandth the dimensions of the original."

Now I might say something about the use of the cold mold, but suffice it to say that with the present investments molds contract on cooling from 5 ten-thousandths to 35 ten-thousandths, according to the investment employed, less than their size prior to heating, which only serves to accentuate the contraction of inlays cast in such a mold.

I have the opportunity here today to extol this fellow townsman and a most unselfish co-worker in the field of dentistry, Dr. Weston A. Price, a man who, like Dr. Black, was so worthily eulogized at yesterday's session by our fellow member, Dr. Friesell. Just as Dr. Black has brought out of chaos into systematized practice the field of operative dentistry by determining the causes of failure in the filling of teeth and in finding and proclaiming an adequate remedy, so has Dr. Price been an indefatigable worker in the study of the subject of the gold inlay; not only is he a blazer of trails in this department of operative dentistry, but I am sure you will all agree with me that he towers head and shoulders above the rank and file even of the small minority of the profession who attend dental society meetings.

Some one has said, "Show me the books a man reads and I will tell you the kind of man he is." We will all agree, I think, that this holds true equally with the kind of friends he selects, and if perchance he be a dentist, even by the kind of instruments he employs.

I was once visiting a dentist's office and I happened to see his set of excavators and behold! what a mess of rubbish they were, but not merely that, they were so dull that I questioned whether they had seen an Arkansas stone since they left the manufacturers. I instinctively put that man down as one not to be emulated.

Now, if good instruments are to be the gauge of excellence, let us, or those of us who have not done so, not only adopt the beautiful instruments of Dr. Black's designing, founded upon experience, with angles and dimensions all scientifically determined with great exactness for the work they are to perform, but let us also adopt as an instrument for saving teeth, the artificial stone suggested and advocated by Dr. Price.

Closing remarks of the essayist:

MR. PRESIDENT AND GENTLEMEN: We are exceedingly sorry that train time for our departure is so near at hand that the discussion of the paper under consideration could not be prolonged; there being yet many points upon which we should like to have heard an expression of opinion. The operation of casting is as standard as any of our present day operations, and the problems which it involves merit the most thorough attention and research possible. A comparison of differences of opinion on the subject is—from an educational standpoint—second only to exhaustive scientific experimentation. In order that the result of experiments may obtain as a means to an end, such experiments must be, or have been, conducted along lines that are strictly scientific, and in absolute accord and harmony with such laws of physics as are known to be inflexible.

Dr. Lodge has indeed given us much material for consideration, and has presented it in true masterly fashion. His discourse is largely in the nature of an interrogation. We welcome the interrogation, and would have preferred it to have included many other points. We have jotted down the various questions asked by Dr. Lodge as well as we could get them in hurried fashion, and if we have failed to get them all will call upon Dr. Lodge to restate such as are not in evidence.

Dr. Lodge seems to be a firm advocate of the "indirect" or impression method, and takes exception to our statement that by the impression method there are too many transfers. He states that by casting in a model of artificial stone the number of transfers is the same as by the "direct" or pattern method. This is not correct. The little joker which he interposes in saying, "The model made in the impression becomes a part of the investment," almost conceals the truth. Unless it was *all* of the investment his criticism does not hold good, and the best he can do is three transfers for a part of his wax pattern, and four for the balance of it—as against three transfers throughout by the direct method. The number of transfers by any method is of less consequence than the integrity, or questionability of such transfers, or the possible element of inaccuracy in handling the transfers, and we must still insist that—as stated in the paper—there is vastly more possibility of distortion in an impression than in a

pattern, and for the reasons stated. We all know that a plaster impression is almost invariably broken while being removed from the teeth—even though that impression includes a very small area. Why does it break? Because the shape of the tooth, or teeth, is such that the rigid plaster cannot come off over larger portions of the tooth, or teeth, or follow varying axial lines of the enclosed teeth, without breaking. The same condition that breaks a plaster impression bends a wax or compound one. Granting that the outer surfaces of the teeth and the interproximal spaces are of such shape that an impression would draw without bending or breaking, it yet remains that the prepared cavities in those teeth must have exactly the same line of draught. This latter is a very exceptional condition, and when obtained at all, it is usually an unnecessary expense of tooth structure.

The models shown by Dr Lodge show beautiful work. Articulation and contact points just right. And the inlays fit the cavities absolutely. Naturally, having been cast therein, and not removed since. But, how can any one here determine by examining these models whether the impressions in which they were made were distorted or not? If this model is accurate, then the impression in which it was made must have been accurate; if the wax impression was accurate then the teeth over which it was taken must have had no contour—or at least could not have been larger at the coronal portion than at the gum line; all the teeth included must have had their axial lines parallel; all the prepared cavities must have had their lines of draught exactly parallel with each other, and all parallel with the long axes of the teeth. Can we conceive of finding such a condition in ordinary practice more than once or so in a lifetime? And unless the conditions as enumerated are present in a given case, distortion of a wax impression must be expected—even with all the preventive possibilities that the neat little trays can provide.

Dr. Lodge tells us that a pattern can be made quicker in a model than in a tooth. In some cases this can easily obtain. But when we consider the extra operations—such as taking an impression, taking a bite, making a model and fusing it, placing the model and bite on an articluator—we are then, by the impression method, only ready to begin the same routine of operations that would entirely complete the case by the pattern method. Time is money. Either the patient or the operator must lose by the slower method.

Dr. Lodge asks how we would get the needed pressure on the contact point. We do this by inserting the sprue wire at this point. The sprue wire we use for ordinary work is 0.070 in. The extra pressure for the contact point is thus gotten without any extra operation, or apparatus.

Dr. Lodge also asks how adjoining contact points can be gotten by the direct method. There are various ways. One is—press pattern wax into both cavities; bite, rough trim, and separate the two with a thin ribbon saw; then finish each separately while the other is in position. Place the sprue wire in each at the contact point to get the needed pressure. Another method is—first make one pattern, and while it is in place adjust an oiled matrix to the other cavity, and make the second pattern in it. (An "Ivory" matrix works very well for this.) Place sprue wires as stated. Still another method is—that one cavity can be completed at a time.

Dr. Lodge asks how we hold the inlay while polishing. We do not hold it while polishing, having always maintained that the only proper place to polish an inlay is in the tooth after cementation. We do whatever shaping is necessary where the riser is cut off, while holding the inlay in our fingers; using great care to not even approach a margin. An inlay is not ready to be polished until it has been cemented in the cavity, and its margins burnished before the cement has become friable.

Dr. Lodge also asks how we prevent the gold from shortening mesio-distally. This is accomplished the same as for any other dimension. As stated in the paper, it is easily possible to make a casting in the investment given, that has a shrinkage of only .16 of 1 per cent. Granting that we have a casting that has a zero measurement (no shrinkage), we could not seat it in cement. Cement occupies space. As stated in the paper, one dimension of an inlay for a double compound cavity should be a trifle larger than the cavity, and the other dimension smaller than the cavity. There is as yet no means of bringing about such a condition. The pattern for such an inlay can be cut away from under the center until the resultant casting will stretch enough to allow for what little may be necessary.

Dr. Lodge asks how we correct for distortion of the cavity surface due to pressure upon the investment. We obviate the need of any correction by using a definite pressure that does not distort the mold. We cast under a pressure of 25 lbs. (air pressure) per square inch. And having tested our investment up to 45 lbs., we know that we are absolutely safe at the former figure. Furthermore, high pressures are not necessary. The only argument ever advanced in favor of high pressure is that shrinkage can be partly overcome by that means. We have experimented with pressures ranging anywhere from sharp margins (5 lbs. per square inch) to the strength of our investment (45 lbs. per square inch) and in that range, any variation in contraction due to varying pressures could not be detected by a vernier micrometer. Inasmuch as by the artificial stone method a part of the mold is made of ordinary investment material, Dr. Lodge's question would apply to that method as well. Beads on a casting do not indicate a distorted mold. They indicate faulty technique in placing the

investment material on the pattern. The same could obtain in placing the compound for an artificial stone model in the impression. Undue pressure will force, or distort, a mold as a whole. Not as beads. Beads will not form unless the spaces for them are already there.

Dr. Lodge quotes Dr. Price on pressures, contraction, etc. While we must admit that Dr Price has worked out a beautiful technique on theory, yet we have not been able to obtain from his writings —and we believe we have read most, or all, of them— certain data, or technique, that must of necessity belong in order that his technique may obtain as he claims for it. This data is—*the temperature that the mold must have at the moment of casting, and a means of determining that temperature.* Dr. Price has ingeniously devised an artificial stone that has a permanent expansion equal to the normal expansion of gold up to its fusing point. Granting this equalization, then any rise in temperature in the flask at the moment of casting means an increase in the size of the casting over and above zero measurement. In order to roughly demonstrate to you the effect of variation of temperature in the flask at the moment of casting, we have here a small mandrel on which are two gold rings. The mandrel has a taper of 1 degree; the patterns for the rings shown here were made at exactly the same point on the mandrel; both were invested in the investment material that we have advocated, and from the same mix, or bowl of batter. There could, therefore, be no possible difference in physical conditions thus far. One ring was cast in a mold as hot as the fusing point of the brass flask which contained it would allow, and the other cast in a flask that was cool enough to handle with the fingers at the moment of casting. You will notice that one ring drops to within the tiniest line of the point where the patterns were made, and the other ring stops about 3-8 of an inch further up. Therefore, in order to make a given technique complete, data for the temperature of the flask at the moment of casting should be given.

The figures given us by Dr Lodge—giving the effect of pressure as determined by Dr Price—are in error. Dr. Price obtained these figures by experimenting in casting with a centrifugal machine. In the same article in the *Items of Interest*, wherein Dr. Price gives us these figures, he states that in computing pressure in such a machine, the entire mass of gold in the crucible is available, and must be reckoned in computing the pressure on the sprue area. This is unquestionably an error. An inflexible law of physics teaches us that the only bulk of gold available for pressure and computation, under such conditions, is a bulk equal to the area of the narrowest part of the sprue opening, and the length of which is the height of gold in the crucible. All the remaining bulk of gold that fills the rest of the funnel-shaped crucible adds absolutely nothing to the pressure on the actual sprue area. Therefore, all the figures that are based on this theory and method of computation, are certainly in error. We recall having seen cuts of a device that was to produce perpetual motion, and will sketch the same on the blackboard. The device is a funnel-shaped receptacle, having a long curved neck or spout, that curves aside, upward past the body part, and again curving so as to have its final opening directly over and pointing toward the open top of the larger or funnel part. The belief was, that water placed in the large part of the device would exert so much force through the small curved spout that a continuous flow would be established around and into the original receptacle. Of course, it did not work, and for the reason we have mentioned.

As we stated a few moments ago, unless all these experiments are worked out on a truly scientific basis, and in strict harmony with the known inflexible laws of physics, such research can avail little or nothing, as a means to an end.

CAST PINS FOR CROWNS

By W. A. Stewart, D.D.S., Kansas City, Mo.

This pin is to be used when and where a pin is needed in a tooth; for example, a Richmond crown, to help anchor inlays, in broken down teeth, or to be used in root or roots of molars that are to be built up.

ADVANTAGES

1. It is tailor-made and fits.
2. No part of the tooth is taken away that is not filled by the pin.
3. It tapers, making it the shape of the root, and does not weaken the tooth at farther end of pin, leaving it plenty large enough at the other end.
4. Never fits until it is in place, leaving plenty of room for cement to be displaced.
5. The pin is made before the patient comes, and will fit as soon as it is placed in the canal.
6. Always stays in place while working around it before it is cemented.
7. Impression is not taken in wax.

DIRECTIONS TO MAKE

Fill the ring with investment and let it dry; drill a hole with reamer in investment, then cast; drill a hole in the tooth with the same reamer, any depth desired; try pin in and see that it fits; if it is too long cut it off. I use 22k. gold.

A METHOD FOR CASTING BACKINGS FOR ALL-PORCELAIN FRONTS FOR CROWNS AND BRIDGES

By D. Haight, Coshocton, Ohio.

Take any of your old cast-off facings or broken plate teeth that have no pins, of any shade that will suit the case, or a Steele facing, and grind flat like a Steele facing. Grind it on the cutting edge as sharp and thin as you can. Grind off the cutting edge to be supplied the same length you would grind the porcelain for a gold tip. Take a knife-shaped carborundum stone and cut a groove lengthwise about the depth of a Steele facing, having the walls parallel. Take inlay wax, shape it as you want your backing, and have a good tip on cutting edge, for these are the secrets of success; then remove and cast. After it is cast cut serrations in the gold lug with a knife-edge carborundum and cut little undercuts in groove. See that your facing fits perfectly to the backing. When you use for bridge or crown work, just before you invest, be sure and use antiflux so that no solder will run where your facing goes. I find Harvard cement the best for cementing the porcelain to the backing. I have had perfect success with this work for over fifteen years. By burnishing platinum on facing, the same as porcelain filling process, but since the process of casting, it is much more simple. In case of breaking one out another can be ground in without taking off the bridge.

RESTORATION OF BADLY BROKEN-DOWN ROOTS WITH ACOLITE

By James B. Lester, D.D.S., Christianburg, Virginia.

The saving of badly decayed roots is a thing too often neglected by the dentist. I have reference to those roots where decay has progressed far beyond the cervical portion.

In my judgment the condition of these teeth arises from one of two principal causes; first, many persons fail to realize the importance of caring for the teeth until they are badly broken down, and then they present themselves for extraction because of alveolar abscess; second, many people are too miserly to have their teeth cared for until they have lost a large number, and they realize their inability to properly masticate their food.

The first class can generally be convinced of the importance of caring for their teeth. The second are easily convinced that their teeth are important to them.

In mouths of this class of patients we often find roots that are covered with gum tissue. After the decay is removed the end of the root is beyond the cervical line, hence, in my opinion, it cannot be restored with any material that is placed there in a plastic condition, because it would be impossible to make a restoration smooth and of proper contour beyond the gum line.

Because the restoration of these roots to their normal usefulness is tedious, many dentists condemn them to the forceps and replace with bridges.

In my practice, if there is two-thirds or three-fourths of a root left after the decay is removed, and that portion solid, it is worth an effort to save.

When these cases present themselves for consideration my first step is to remove all decay as nearly as possible. This will generally cause hemorrhage from the wounded gum, which is stopped with adrenalin. The end of the root is thoroughly dried, and the canal or canals treated with formocresol. A piece of temporary stopping of sufficient size to fill the cavity (in gum) is thoroughly softened and made into a cone, or other appropriate shape, and forced in place so as to move the gum tissue out. The patient is dismissed to return a day or two later, and at the next sitting all decay is thoroughly removed, the canal cleansed and again treated with formocresol, and the cavity packed as before. The patient is dismissed for five or six days and on returning the canals are sealed at the apex, if they are in proper condition; if not, this is done at a later sitting. The end of the root will generally be well defined, and you are now ready to begin the restoration.

If the root is an anterior one an all-porcelain crown with attached pin is selected that is long enough to allow the porcelain to extend beyond the gum margin, thus avoiding the possibility of a dark joint at the gum line. The pin is ground to proper length, and inlay wax that has sufficient rigidity to stand carving is chosen. (I personally prefer the Standard, put up by The Ransom & Randolph Co.) A sufficient quantity of this is softened and placed around the base of the pin, so as to leave an excess. While the wax is fairly soft the crown is pressed into place and held firmly until the wax is hard. Crown and wax are now removed, the wax is trimmed to the size of the root and crown, the piece is again put in place to ascertain if the adaptation is perfect. A sprue wire is attached and the case is invested as directed for casting

acolite. That process I will not describe here as it would be taking unnecessary time. After casting, the metal is polished and the work tried in to ascertain if the adaption is now perfect. If it is, the piece is set with cement, care being used to have as little excess cement as possible, as it is more or less difficult to remove excess from under the gum and any left would act as an irritant.

If the root is a molar, and you wish to use a gold shell crown as an abutment for a bridge, pins are arranged parallel to each other in the enlarged canals. A large piece of wax is softened and pressed up on pins, and allowed to harden. Wax and pins are now removed, the wax is trimmed to the size of the root as shown by the impress. If the wax does not extend sufficiently above the cervical line, more wax is softened and shaped on the end of the piece already in hand. The piece is now invested and cast. By this method we have supplied a stump to which a gold shell crown is easily adjusted.

I have suggested the use of acolite in the restoration of these roots because it can be done at a much smaller cost to the patient than would be possible if gold was used, and at the same time done well.

Where molars are too badly decayed to fill with amalgam and on account of cost the patient cannot have gold inlays, this same method may be used to make acolite inlays that will give comfortable service.

CAST ANTERIOR BRIDGE ABUTMENTS AND VARIATIONS OF THE SAME FOR PERMANENT SPLINTING OF LOOSE TEETH

By George C. McCann, D.D.S., Danville, Ill.

Doctor McCann's table clinic demonstrated the technique and use of two anterior bridge abutments—one consisting of a root canal dowel, with lingual and proximal gold backing attached. The enamel of the tooth (preferably six anterior) being ground so as to accommodate the occlusion with sufficient thickness of gold. The margins of the backing carried to self-cleansing areas. The other consisted of an anterior attachment for a live tooth (preferably bicuspids). Trimming the lingual, occlusal and proximal surfaces to accommodate thickness of gold and to self-cleansing areas. A groove is then produced with a millimeter cross cut fissure bur over the proximal and occlusal surfaces.

Splints for loose anterior teeth were modifications of the abutments. For the lower anterior, axial directed pits, 1.5 to 2 m. m. in depth were made on the lingual. Into the pits stub pins were placed and a casting made supporting pins and furnishing a solid lingual backing to the teeth; a splint was then soldered to either form of bridge abutments placed on sound teeth.

A posterior splint consisted of a wire placed in an occlusal groove of loose teeth and supported by inlays located in sound abutting teeth at each end.

The purpose of the clinic was to present strong esthetic abutment of anterior work by confining the case to the lingual aspect.

ANCHOR FOR FILLINGS AND INLAYS

By W. H. Pelton, D.D.S., Fostoria, Ohio.

Every dentist has experienced the difficulty of anchoring large fillings and inlays, particularly in approximal cavities, where the gingival and incisal portions are involved in the cavity. The failure of such fillings is due to the fact that we depend upon frail enamel and cement to anchor the filling or inlay. Naturally, these elements have a lesser resistance than the filling or inlay.

The anchoring device I here present is so fashioned that it forms an interlocking union of metal with the tooth and filling that has as great a resistance as the tooth or filling. With the anchor you depend on a 22 gauge 18k. gold post set in the sound dentine to anchor the filling or inlay at the incisal edge and at the gingival portion one end of the anchor is set in the sound dentine. The anchor post is bent at a right angle and interlocks with the anchor, forming a positive lock of gold with the tooth and filling or inlay.

We will consider first the preparation of a cavity in a central for a gold filling, it being unnecessary to devitalize. After removing decay, take sandpaper disc and cut the labial and lingual enamel parallel with the long axis of the tooth, then with a carborundum stone cut a flat gingival seat. Bevel the labial and lingual enamel

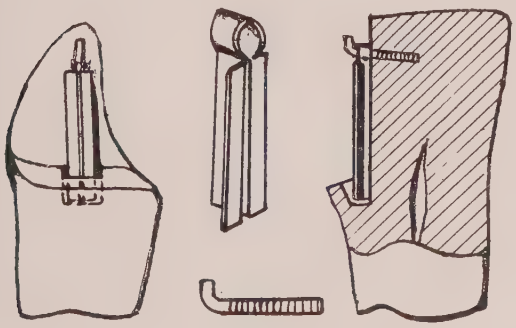


Fig. 1

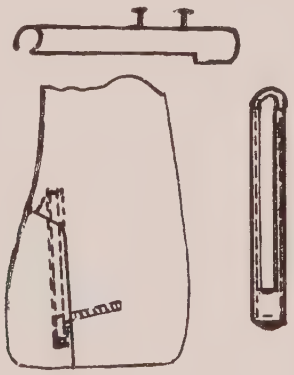


Fig. 2

according to your own idea and build up the pulpal floor with cement until it is flush with the labial and lingual enamel, leaving no undercuts or concave surfaces. Drill a hole (Fig. 1) in the gingival seat to receive one end of the anchor and drill a hole in the pulpal wall near the incisal edge at an acute angle with the pulpal wall. Place one end of the anchor in the gingival pit and pass the anchor post through the hole in the anchor and into the hole in the pulpal wall previously filled with cement. The anchor is so formed that flanges are bent at a right angle and extend labially and lingually. The gold is condensed between the pulpal wall and the flanges, and as the filling is built up each portion of gold is interlocked with the anchor. Non-cohesive gold can be used in the first two-thirds and cohesive in the remaining. This anchor is indicated in bicuspids and molars where large cavities are restored with amalgam. It is unnecessary to involve the enamel in the retention of the filling —the anchor will resist the stress and retain the filling.

The casting machine created the greatest enthusiasm among the dentists, yet many a man has to regret that the cast inlay has been expensive to his practice,

yet the failure of gold inlay in large restoration is due to the cement not being strong enough to resist the stress. The anchor enables us to go one step forward, which gives us an inlay with a mechanical retaining device. The cavity for inlays is prepared similar to the cavity in Fig. 1.

We will now consider an inlay in a central (Fig. 2).

Cement the pulpal floor flush with the labial and lingual walls, leaving no undercuts; drill a hole in the gingival seat with a round bur, to receive one end of the anchor; then drill a hole near the incisal edge for the post; now cement the post to place with the right angle part parallel with the long axis of the tooth and pointing toward the incisal edge. Continuing, place the tube part (Fig. 2) of the anchor in position in the cavity—seeing that the full round part of the tube interlocks with the post, then adapt the inlay wax and carve the wax to conform with the tooth. Now remove the wax model by pulling it straight away from the cavity (there being no undercuts the wax will come away without being distorted). The tube part of the anchor will come away with the wax. Invest the wax model with the tube part of anchor in place just as it is taken from the cavity. The tube must be filled with the investment (using a camel's hair brush). When you cast, the gold will fuse to the anchor, making the anchor and inlay in one piece.

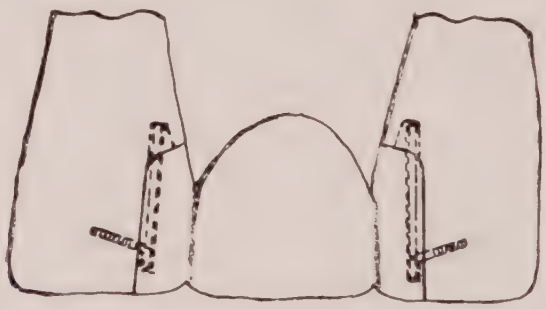


Fig. 3

In using the inlay anchor in the construction of bridge work (Fig. 3) the cavity is prepared similar to inlay in Fig. 2. The anchors are placed in position and the cavities built up with the inlay wax; a suitable facing is then attached to the wax in the cavities, then the wax model is removed and invested as in Fig. 2 and cast. This will give you a beautiful piece of work that is sanitary and is constructed with less sacrifice of tooth substance than by any other known method.

CAST POSTS FOR STEELE'S FACING

By George H. Walker, Los Angeles, Cal.

This is a portion of a gold rib cast. One end is cut and shaped for the anterior teeth and the other for posterior. Wax is forced about the rib when in tooth and shaped to suit. Facing then removed and the wax invested and a casting made as per finished tooth.

A sheet of base-plate wax is placed on a flat surface at the edge, and, beginning with the largest hole, the draw plate is drawn over the edge of wax, gradually cutting wax down to size of smallest hole. Wax is then cut from sheet, forming strips, as per sample—a sprue attached to one end—coiled like watch spring, flasked and cast. Wax must be chilled to draw nicely.

METHODS OF CASTING IN CROWN AND BRIDGE WORK

By W. G. Crandall, D.D.S., Spencer, Iowa.

ALL CAST CROWN

It is possible to cast an entire gold crown, and it is at times practical. It makes a piece of work that is heavy, expensive and difficult to handle.

It is always necessary to have a tooth perfectly trimmed of all enamel before starting to make a crown. It is absolutely essential that there be no overhanging wall of dentine.

If the tooth has one or more walls of dentine, build it up with amalgam so that the walls slightly converge toward the occlusal. Next give the surface a finish with strips or discs. The casting wax may be applied directly over the prepared tooth if the operator is skillful enough to carve and finish while in position. This is not an easy thing to do unless the gum has previously been forced out of the way to give access for convenient finishing about the root.

The easier way is to take an impression with gutta percha, metalline, modelling compound or cement. With a burnisher work the impression material close about the root, being sure that the impression is perfect. Do not allow the impression to interfere with occlusion. When the impression material is thoroughly hardened take the bite with modelling compound or wax, bringing away the root impression in position in the bite material.

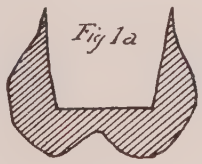


Fig. 1a

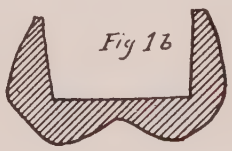


Fig. 1b

The root impression should be coated with some separating material and then filled up with cement; either build down quite long or rough so that it will be held firmly in the plaster model or insert metal pins for that purpose.

The case is now ready to place in crown articulator and pour up with plaster.

When hard, remove the bite and impression and you have an exact reproduction of the tooth, approximating teeth, occlusion and surrounding parts.

Either wet or oil the model, then proceed to melt on the casting wax a few drops at a time and carve to form. It is possible to give form to a crown in this manner that it would be very difficult or impossible to form with contouring pliers. A fit beneath the gum line may be made as perfect as that of any inlay and this is more than can be said for most gold crowns.

A most perfect fit at the gingival line may be made by cutting a seat at right angles to the long axis of the root upon the mesial and distal surfaces just beneath the free margin of the gum (Fig. 1) and finishing the crown flush with this line.

The possibilities of the contacts and contours are limited only by the variety of cases and the skill of the operator.

CAST CUSPS

In making cast cusps for a crown the band should be made in the usual manner, paying very little attention to contour. Take bite or impression in the usual manner and place on the articulator. A thin film of wax within the band at the gingival portion will facilitate its removal when upon the model.

The root model may be built down with plaster so as not to leave room for too great a thickness of casting wax and a subsequent thickness of gold. The wax can be melted over the surfaces of the band, giving buccal, lingual and approximal contour with precision. The occlusion can be tried and carved to an exactness.

The waxed up model of either variety of crown should be thoroughly trimmed and smoothed (gasoline or chloroform is good for this purpose) so that none of the contour need be filed or polished away.

Fig 2.

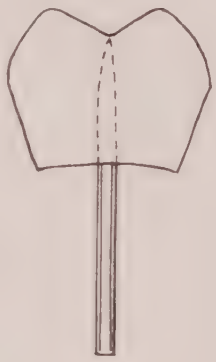


Fig. 2

The sprue wire should be inserted into the wax of the occlusal portion within the crown (Fig. 2). This is important when casting upon bands, as will be seen later.

In investing these crowns they should be placed as near the surface of the investment as the strength of the investment will allow. It must be remembered that the occlusal surface of most crowns is quite a large surface and there must be sufficient investment material to warrant a resistance to the molten gold when it is thrown against it. It has been my experience that a depth of from 3 to 5 m. m. should be allowed for sufficient strength.

After the investment material has become sufficiently hard (15 to 30 minutes will suffice for most investments) the sprue wire should be removed and the case inverted over a flame that will melt and burn out the casting wax. When the investment becomes red with the heat it should be inverted and heated until the investment can be seen to be at a white heat through the sprue hole. This is important, for the gold will not fuse to the band unless it is well heated. A failure will be unknown if the case is thoroughly heated and properly cast.

If a taper pointed sprue has been used, the crown when cast can be easily separated from the cast sprue by twisting in the fingers. A separation can be had at just the right point if care has been used in placing the sprue in the wax and an excess of wax not allowed to adhere to the sprue. Any excess remaining can easily be cut out with a bur or small stone.

A crown made after this method will need very little polishing to produce a beautiful result, providing care has been taken in every step.

The Richmond Crown is practical upon any of the teeth that will admit of a sufficient length for the porcelain facing.

BRIDGE WORK

We will suppose that the gold crown we have just cast is for the upper left first molar, the two bicuspids are missing, the bite is very close and we want to place a Richmond crown upon the left cuspid and bridge the space.

Before making our Richmond crown we will trim the root a little differently than the usual custom. The labial half of the root end is beveled beneath the gum line with a root facier and stone as for a Logan crown. The lingual half of the root end will not be beveled nor cut down to the gum line, but will be cut flat, making a good seat for the crown. The enamel should now be thoroughly removed from the root (Fig. 3).

An iridio-platinum wire about 16 gauge is fitted to the canal and left protruding from the root end about 2 m. m. A suitable facing is ground to position, allowing room for a gold tip for the protection of the facing. The pins should be bent so as not to interfere with occlusion or the contour of the crown.

A piece of casting wax of sufficient size should now be softened, or better, melted upon the back of the facing, approximating the shape of a crown, and the root pin inserted. This, while soft, should be forced upon the root, the facing adjusted to

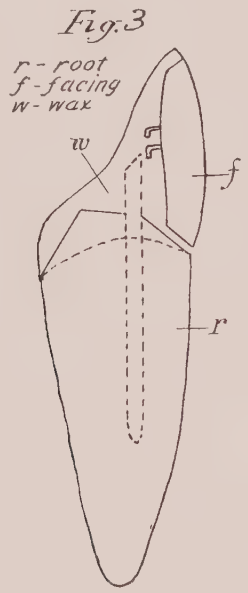


Fig. 3

the desired position and occlusion carefully noted. The wax should be tightly burnished about the root with cold burnisher. After thorough adjustment, chill and remove for careful trimming. Casting wax that is sufficiently hard to admit of handling and trying in the mouth without danger of changing form, should be used. When the desired form is secured and the wax smoothed the sprue wire should be inserted in the wax upon the lingual surface of the crown at right angles to the back of the facing.

Great care should be taken that no wax extends over the labial, mesial or distal surfaces of the facing as this would be liable to cause a check in casting.

This arrangement places the facing in the position to receive the most possible heat in the investment. The investment should be made the same as for the gold crown, the wax melted out, the case inverted and heated slowly at first, gradually

increasing the heat to the extreme, so that when the hot gold is cast upon the facing there will not be enough difference in temperature to cause sufficient expansion to check the facing.

The moment the cast is made and the gold has hardened the case should be covered with dry plaster and left until thoroughly cool. Most of the failures in casting onto facings have been due to rapid cooling. Powdered plaster will keep the case warm for about a half hour or more and it is time saved to leave it plenty long enough.

A crown made carefully after this method should go to place on the root as perfectly as any inlay and if properly finished should never become an irritant to the gum tissue.

To complete our bridge we will place the crowns in position and take accurate bite and impression. This is easily done with plaster on the Detroit bite impression tray, bringing the crowns away in position and allowing no chance for change of bite.

The inside of the crowns should be coated with a thin film of wax and the case mounted in plaster on the articulator. Separate and warm crowns sufficiently to melt wax and thoroughly clean out all wax so that crowns rest perfectly in position.

Bicuspid facings are now ground and fitted, casting wax applied to them, and while warm they are placed in position and the articulator closed and worked about as in chewing. Now carve cusps and trim wax as you want the bridge when finished. Use great care that wax does not overlap the facings in any position. It should cover the same portion of the facing as you would include in backing a tooth for soldering. The case should be invested and cast the same as the cuspid crown. It is now ready for assembling. This is not done in any way different from the ordinary procedure, with the exception that very little solder is necessary.

This makes a bridge that is nearly perfect hygienically. There is no space between the facing and gold as with ordinary backing, there are no solder pits to cause trouble in finishing. The crowns fit like inlays, allowing a minimum of cement which we all know is the foulest of substances when removed from an old crown.

The color of the gold should be uniform, the same kind of gold being used throughout.

In casting anterior cases where it is desirable to have the case thin linguolabially, I would suggest clasp metal. Though difficult to melt sufficiently to cast, it gives the maximum of strength and rigidity for its bulk.

If it is desirable to have the facings removable, the backs of the facings should be oiled and the pins left straight. After the waxing up has been completed, remove facings and place sharpened pencil points in the pin holes, having the points long enough for the investment to hold in position for casting. Facings can be easily adjusted and cemented to position after bridge is completed.

Another good method for making facings removable and a strong attachment when in position, is done by bending the pins down on the facing so they lap, and as close together as possible. Then cover with soft solder or some of the easily fusible metals. Grind this into a box form just so that it can be withdrawn from wax without pulling. This makes a very strong attachment and is easily and quickly made.

AN IDEAL BICUSPID OR MOLAR CROWN

By George S. Schlegel, D.D.S., Reading, Pa.

An ideal artificial crown is one that possesses all the qualifications of its natural predecessor. In fact, the artificial substitute cannot decay, can be easily repaired if broken, and very often makes a better appearance than the natural tooth, when the latter is affected with atrophy of the enamel, discolorations, and partial fractures. In order that I be not misunderstood, I wish to inform my readers that a tooth should not be crowned unless it cannot possibly be repaired with some permanent filling material suited to the class and position of cavity or cavities.

The crown I wish to describe is made possible by the application of the principle of casting gold under pressure. The method can be used for any tooth in the mouth, but is especially adapted for bicuspids and molars. No ethical dentist should place a gold crown on the oral teeth, but bicuspids and molars are crowned by them, with the hollow shell crown, because the repertoire of crowns used to date lacked one that possessed both the necessary strength and esthetic qualities. I will point out the value of this crown to others now commonly used by comparison at the conclusion of this article.

In order to give you a clear conception of this method, I will describe how to make a superior first bicuspid crown:

The proper preparation of the root is essential for the proper adaptation of the crown as for any other crown. The root should be filled with red gutta percha points, which serve as a guide in reaming the root canals, the little red spot indicating the direction of the root. The diameter of the canals should be enlarged in proportion to the diameter of the root. I use No. 16 to 20 gauge iridio-platinum wire in the roots.

The next step is to cut down the root flush with the gum line. Then bevel root on the buccal side, and palatal side to about one m. m. below the free margin of the gum. Take a No. 5 or 6 bur to countersink opening to the reamed root canal to the depth of 1½ m. m. I insert iridio-platinum wire into each canal, cut flush with surface of root, and remove to bracket table for future use. This completes the root preparation.

The next step is the selection of a porcelain detachable crown of any make desired, but of such a size and color that will conform to the case. If necessary to grind to occlusion, grind the occlusal surface; the reasons for this I will point out later.

Now take a piece of black inlay wax of a rather stiff quality, like S. S. White's, and after lubricating the inside of the opening of the artificial crown with a little sweet oil or glycerin, press the wax, which was previously warmed, into the opening of the tooth. Withdraw to see if the undercuts in the tooth interfere with proper removal, and if they do, correct the fault. Return wax to crown, and trim approximately. Warm slightly and press crown with wax to the root. Note the condition of occlusion, position in arch, etc., then chill with iced water and remove. Note the opening to the canals by the elevation in the wax. Heat the iridio-platinum pins previously fitted in the roots, and place in approximal position in wax. Return

to root for final adjustment. Be sure that all the wax is hidden beneath the gum. Chill again, remove carefully from root, then remove wax from the crown. Carefully insert a sprue wire at the end of the wax with pins, which touches the remotest part of the opening in the artificial crown. Invest and cast according to any of the methods used in casting gold inlays. Cement crown on cast base, and then cement the crown and base to place.

This gives you a crown that is perfectly adapted, esthetic, durable and easy to repair. The reason for grinding the occlusal surface is obvious from the fact that repairs would be easier if a record is kept of the number of the mold used, then a tooth of the same mold will fit the case without any grinding at the gum line.

It is my firm conviction, gained from actual experience with the insertion of these crowns for a period of over a year, that they are ideal. They are better than a gold crown for esthetic reasons. Better than a Richmond crown because in this ideal crown no band is needed, for bands are an abomination at best, and unless a Steele's Detachable Facing is used, the color is often far from satisfactory. Again, gold tips are unsightly. Better than a Logan crown because it is very often difficult to adapt to the root. Again, the leverage on the pins is very great, and often ends in the splitting of the roots. Better than a porcelain or platinum jacket crown, because either is liable to fracture, and difficult to repair.

CAST ABUTMENTS FOR THE ATTACHMENT OF BRIDGES

By W. M. McCall, D.D.S., Louisville, Ky.

Cast abutments for the attachment of bridges, using in this case, superior left cuspid to first molar.

Prepare the cuspid, first by removing with the stone sufficient amount of tooth structure from lingual portion of tooth to give room for construction of inlay. Grind two small grooves across lingual surface, then with small round bur make three openings, two towards incisal, one towards gingival. In grooves which were made in tooth, fit number twenty (20) platinum wire and proceed to construct the inlay in the usual manner.

To prepare the molar tooth, grind off occlusal surface, starting at lingual and gradually tapering towards buccal surface. Then cut cavity in mesial portions, extending under free margin of gum, and from lingual to buccal of mesial surface, placing in the occlusal two or three number twenty (20) platinum pins, so as not to come in contact with the pulp of the tooth. Proceed to construct inlay in the usual manner. Place inlays in position, take bite and impression, using for dummies Brewster's diatoric teeth. Grind up dummies, swage backing and solder as in ordinary piece of bridge work. A bridge properly constructed and attached by this method is very strong and durable. The main feature is that no gold shows on labial and buccal surface.

THE SCOPE OF CASTING IN DENTISTRY

By R. C. Brophy, M.D., D.D.S., Chicago, Ill.

While casting metals in dentistry is by no means of strictly modern origin, it is only of late, or following the announcement of the application of the principle to operative work by Dr. Wm. H. Taggart, that it has come to be regarded with particular interest by the profession. It is doubtful, however, if, with all the interest shown at the present time, the complete scope of the work, or full field in which it is applicable, is properly appreciated.

It is not the purpose of the writer to dwell upon the casting of inlays proper, as substitutes for fillings, for that subject is being widely discussed, and is quite well understood, but I would, taking that as a starting point in consideration of my subject, follow along further and take up other things in the same field.

I have always felt that there are possibilities in the process of casting in dentistry of really greater value and importance than the casting of inlays to fill cavities in the crowns of teeth.

Making use of inlays is dependent upon the extent to which destruction of the crown of a tooth has been allowed to proceed; their applicability must be measured by the proportion of the crown remaining; there must be a given area of sound, solid tooth structure to support them. Many cases present where there is not such sufficient sound structure, and it is in such instances, in the writer's opinion, that there lies the greater possibilities of valuable accomplishments through the casting process.

It is a pity that teeth are allowed to pass beyond the pale of repair by simply plugging cavities; but the time will never come when the dentist will not meet conditions either presaging the complete loss of the tooth, or, exacting extreme ingenuity and skill in its saving. It is not so much a question as to whether the dental profession could keep everybody's teeth in normal condition, and intact, as it is a fact that it never will have an opportunity to do anything of the kind. People sometimes neglect to lock the barn door until after the horse is stolen. A great many people never entertain a thought of consulting the dentist until their teeth are so extensively involved in destruction that artificial restitution is demanded.

Then, again, the matter of casting inlays proper applies only to those cases where restoration of a tooth may be accomplished by old, ordinary methods of operative procedure. I want to connect the casting process with those cases which no dentist would think for a moment of attempting to restore by operative procedure, those cases in which the little remaining structure, merely the shell of a root, though it be, are made use of as an abutment or anchorage for a cast restoration, or the mounting thereon of a porcelain crown.

It is scarcely possible to conceive of a tooth assuming a condition of decay, which, from a mechanical standpoint cannot be restored, if the casting process be employed, waiving, however, discussion of the many things that may be done in the way of restoration of the crown of a tooth where the root is sound and solid. I would speak particularly of that procedure which I believe constitutes the most

valuable and important achievement possible in casting. I refer to the mounting of crowns upon badly decayed roots where, possibly, but a shell remains, and this shell buried beneath the margin of the gum.

The method of making such a restoration is so simple that it can but appeal to all. If the shell upon which it is desired to mount a crown be deep down underneath the gum, it will be found that gum tissue has covered, and likely, partially filled it, and in that case this tissue must be crowded back by packing. The root should then be cleaned of all debris and its edge trimmed to a solid margin.

If the restoration is to be made of gold, a detachable pin crown should be used, the dowel, or pin, with the crown in position upon it, should be invested with softened inlay wax and should be crowded down into the root, the latter having first been moistened with saliva. This procedure should give a perfect model of the canal, or shell, and a perfect mold of the base of the porcelain crown. The crown may now be taken off the dowel, and the latter, with the wax model attached to it, may be lifted out, trimmed, reset, removed again and retrimmed, until finally the wax is found to be perfectly adapted. The crown should then be removed, the sprue wire attached, and the case is ready for investing and casting.

If, instead of making the restoration with gold, Acolite be used—and for these cases the writer does not hesitate to say that he regards Acolite preferable to gold—the cast may be made direct to the porcelain, or not, as is desired, and ordinary vulcanite plate teeth and German silver dowels may be used instead of special crowns with their dowels. After the restoration is finished it may be set with cement, and if the crown used be detachable, it may then be cemented in position on the dowel.

The casting process in relation to bridge work is an important consideration, but one upon which I realize that I have peculiar views. I believe that if porcelain teeth of a detachable or removable character could be made use of, and as a matter of fact they might be, that casting bridges would be practical, but I am led to believe that unless the bridge be cast along that line that it better not be cast at all.

I have long felt that casting gold to porcelain is too uncertain and questionable to be practical or advisable. It is true, of course, that a piece of porcelain will now and then be found to have withstood the shock and the effects of the natural changes of the gold, after the two have come in contact, but I know that such occurrences are very rare. In a very great many instances the porcelain plainly shows checks. In very many instances the porcelain appears to the naked eye to be uninjured, but my experience has shown that in almost all cases examination under a magnifying glass will reveal checks. These checks, of course, weaken the porcelain and make it unreliable and unworthy of dependence. I regard the casting of gold to porcelain as impracticable.

What I have said in relation to casting Acolite in crown work applies to bridge work. Acolite, owing to its low fusing point and its non-changing qualities in congealing, may be cast to porcelain without danger of checking it.

Casting metal plates in dentistry has been done in our own country for fifty years, and a study of the subject from a standpoint of evolution is interesting. Dr. James B. Bean, who was the first dentist to experiment in the work, undoubtedly was actuated in so doing by a desire to make use of the then practically new metal —aluminum—for base plates. It is doubtful if the metal was procurable at that time in sheet form for swaging. Dr. Bean attempted to make use of straight aluminum without trying to affect any change in it by alloying. When we realize that pure

aluminum is not produced at the present time, we may imagine the purity of the metal he used at that early time, and, knowing what we do of the effects produced by certain oral secretions upon the "pure" aluminum with which we are now supplied, we may further imagine the troubles which confronted him in practice. It is quite likely, also, that Dr. Bean had his troubles in making perfect casts, for he depended upon gravity to inject the metal into the matrix, or mold.

Following Dr. Bean, other men became interested in casting aluminum plates, notably Dr. Carroll and Dr. Zeller, but without commenting upon their experiences I will consider the matter from a present day status, and purely from a mechanical standpoint, in conformity to the title of my paper.

It may be interesting to some to know that as long as fifteen years ago the writer, as well as other dentists, made use of the identical principle in casting plates that is being employed by many at the present time, in the so-called inlay casting, viz., burying the model, using a crucible former and sprues, burning out the wax and forcing the metal down into the matrix with air pressure.

The casting of plates is an extremely important phase of dental casting, and is found at the present time to be following very closely the wonderful development and gain in popularity of other forms of dental casting. While I do not deem it advisable to make a practice of casting large full base plates in gold, there are cases where delicate horseshoe or saddle plates may be cast in this metal to advantage.

In the casting of Aerdentalloy plates, a well known alloy of aluminum, which has been proven to possess characteristics making it vastly superior to straight aluminum for the purpose, the dental profession has one of the most, if not the most, important of all the many advantageous aids resultant from the process of casting.

Casting in dentistry has a practically unrestricted scope, and its value to the profession and to humanity cannot be computed.

A SIMPLE METHOD OF CASTING PIN AND COPING FOR A PORCELAIN CROWN

By Paul J. Boyens, Weed, California.

Select a detached post crown to fit the case and fit it to the root in the usual manner. Ream the canal with a gradual taper, making the orifice a trifle larger than for the ordinary post. This increase in the size of the cast post at the point of greatest strain will more than compensate for the difference in strength between the cast material and a platinum or iridio-platinum post. Warm a small piece of inlay wax and roll it into a stick that will approximately fit the canal, leaving it a little long. Lubricate the canal, and while the wax is still slightly plastic, work it gradually into the canal. Soften the projecting end with a few blasts of warm air and warm the crown and press it firmly into place. The wax squeezing out all around will indicate that an accurate impression of the root has been secured. Chill the wax thoroughly and withdraw, then with a sharp knife trim off the surplus. Invest in soft material with the crown downward, the wax post serving as a sprue through which to cast the gold. Cast in the usual manner, using 22k. solder or platinized-plate gold. Let the flask cool thoroughly before opening. Various modifications of this method can be made. A plate or a vulcanite tooth may be used, in which case it is advisable to leave the lingual side of the root a little longer.

—*Dental Brief.*

METHOD OF PRODUCING PERFECT MARGINS

By C. Kabell, Chicago, Ill.

The practical value of the cast filling, its ease of manipulation to the patient, and its time-saving advantages are appealing to me as to everyone, and I employ it wherever it shows a saving of time compared with the malleted filling, but I have been forced to change my technique.

Instead of carefully trimming down all overhanging edges I leave a little surplus over all margins and after setting and allowing the cement to harden fifteen or thirty minutes, trim down the edges with gold finishing burs and repeated burnishings.

In doing this care must always be taken that the tool rotates from gold to margin. For example, if I finish an occlusal filling in a right lower molar I trim the labial margin by running the engine the regulation way, from left to right, but reverse the motion when working on the lingual margin and do not forget to lubricate burs and burnishers with vaseline.

By these means I have succeeded in closing the margins perfectly as far as can be determined by ocular and exploratory inspection.

This sealing of margins is necessary in the light of our past experience with cements of the consistency used in setting of inlays, which is the same as has been employed for a few decades for setting crowns and bridge work.

I have removed very few crowns, etc., that did not greet me with that foul odor that cement stores up in its pores, and I have more often than not seen decay recurring under even well-mixed cement fillings.

The thinner the cement the more easily is it washed out and cracks form that invite decay.

In cases where the shrinkage and warping of the filling would be too great to overcome by burnishing, I employ a different technique.

The gingival margin has always been the weakest part of a filling, showing the greatest percentage of recurrence of decay, and it is also the vulnerable point of inlays. As it is in most cases impossible to properly burnish gold to place between the teeth, I help myself by beveling, giving the edge an angle of about 120 degrees.

The corresponding gingival margin of the inlay will show a V-shaped form, the outer edge of which I burnish inward and depend on the malleting to open it sufficiently to make it fit snugly. If, upon examination, I find any opening, I repeat, and only after being certain of a perfect fit will I cement filling into place.—*Items of Interest.*

THE CAST CLASP

By W. B. Caldwell, D.D.S., Hamilton, Ohio.

The cast clasp is the most accurate clasp that can be made. After securing a perfect cast from a plaster impression, proceed to burnish No. 40 tin around the teeth to be clasped, which will keep the wax from adhering to plaster tooth, then take inlay wax and press around the tooth, carve to the desired shape, then attach a small piece of wax for a lug, remove, place on sprue wire, and invest; use regular clasp metal for casting. Cement clasps on case before setting up the teeth, to hold them in position.

By using this method you will have a denture that, when inserted, will give a very pleasing result; it will not spring, but will be absolutely firm.

NUGGETS OF GOLD—INLAYS

By O. E. Lanphear, D.D.S., Paw Paw, Mich.

Our profession has more cause for thankfulness than any other. This we may say reverently, with no spirit of boastfulness in our own strength, but with gratitude to our Creator, who has blest us with the conditions and environments which have enabled us to achieve so large a measure of well-being and happiness for our fellows. To the members of our profession has been granted the inestimable pleasure of striking out in many new untried lines and carrying them to a high degree of excellence. We are the heirs of the ages. We have had to pay some of the penalties co-existent with the conditions in bygone civilization, and in the face of these difficulties, which have called for strenuous vigor and effort, success has attended us and we possess a fixed determination to wrest from the future the measure of success which is the reward of the faithful.

Success in the dental art has reached a great altitude through the special effort expended on the restoration of health and the mitigation of pain. These have been the constant themes of the most fertile human brains of their time, the fruits of which their possessors have laid unsparingly on the altar of human progress. Today our fellow men pay tribute and respect to the profession built upon the results of our unceasing labors. Practical and experienced clinicians have formulated a working hypothesis, so necessary to permanent advancement in any art, and we point with pride to the acumen displayed by our profession in working out the theories. While much is accomplished by the practical clinician it is becoming more and more a necessity to thoroughly understand the theory of all technical procedure, thus placing the art as far as may be in the domain of exact science.

Our ranks include many expert manipulators in porcelain and gold, each having contributed something to the sum of professional knowledge, in cavity preparation, speed or permanency. Some few furnish records of systematic investigations with basic data to aid in reducing the chances of failure to a minimum. Too many are content to understand the "*how*," with no knowledge of the "*why*" of their methods. This accursed professional apathy keeps many practitioners from attaining the front rank and leaves them narrow. Let us be broad and liberal, discreet and discerning, willing and capable in the service rendered.

For the past decade inlaid fillings have occupied a prominent place in our work. Porcelain and gold have held the foremost places and we point with pride to our successful operators who save time and important tissue by their expert knowledge and scientific technique. While we pay marked deference to these men, many of us allow our energies to wane and our ambitions to atrophy. We should be able to use the inlay methods where discretion demands, for they equal

> "Nature's brag, and must be shown
> In courts, at feasts, and high solemnities,
> Where most may wonder at the workmanship."

The dental art requires painstaking study and careful manipulation to obtain ideal results in gold inlays. Trained discretion in the preservation of tooth substance is as great an aid to permanency as extension for prevention or retention.

In simple cavities the seat of the cavity should be flat and parallel to the plane of the defective surface, while the walls should be nearly at right angles to this and slightly divergent. In compound cavities, lateral retention is secured by frictional planes, dovetail extension or pin projection, that will allow the model to be removed without distortion. Any deviation from the desired planes, as pits, under cuts and spherical depressions, should be filled to within one millimeter of the surface with good cement, and carefully trimmed to allow of drawing. When this has set the cavity is moistened and the apex of a warm wax cone is placed against the deepest portion of the cavity and the remainder is pressed to place with the fingers.

In compound proximal cavities, a strip of linen, celluloid or dam should be drawn tight at the gingival border, for it greatly facilitates the work, especially in cases extending below the gingival line. It forces the wax tightly against the cavity walls and gives an approximate contour to a border which demands perfect carving.

The wax should be chilled and the excess removed with a sharp carver, leaving the occlusal full; now heat this surface a little and ask the patient to bite. He is then left to his own devices for a moment to allow him to give it a natural bite. When the wax is chilled again and the articulation is accentuated by carving, the approximal surface is given a full contour and a normal contact. Polish the surface of the wax and remove cautiously with a firm point and a steady hand. Give the model a critical examination and do not hesitate to return it to the cavity if there is any possibility of distortion. If assured that the wax is a perfect prototype of the filling insert a heated sprue pin in the axial plane of a convex surface. This will aid the gold to go directly to its destination *without marring the investment margins.* See that no pits remain at the union of the pin and the model. Place the bare end of the sprue pin in the crucible former in a position that will bring the wax near the bottom of the investment ring. Coat the wax with alcohol and immediately proceed to apply a thin mixture of the investment with a camel's hair brush, forcing the investment along under the film of alcohol, thus excluding the air. *Gradually force this layer off with a thick mix* of the *investment*, filling the ring with the same and bring the model to its position in the ring. In five minutes, when the investment has set enough to be firm, the sprue pin can be heated a little to soften the wax, and removed with the crucible former on it. Now invert the case and place on the heater, where it is slowly brought to the boiling point of the wax (75° C.), when the wax comes out. From this point, the heat may be carried up rapidly and some of the carbon burned out. *Do not carry the heat higher than necessary*, as it has a tendency to distort the space left by the vanished prototype. A liberal piece of gold is now placed in the crucible formed in the investment, heated nearly to the boiling point; when the force of the machine is applied it rushes down the sprue hole, forcing the air through the thin and porous investment, filling the space left by the wax and remaining there under the pressure of the machine until congealed, when it can be cooled rapidly in water. The inlay may be pickled to remove the investment material, the excess of gold cut away on the lathe and the surface given the desired polish. Then try it in the cavity. Make sure of the borders and the little details which insure the permanency of the inlay. When satisfied with the trial, remove the inlay and cement to place with a rocking hand motion, aided by the mallet in most cases. The cavity form must furnish the retention, leaving the cement to hold the inlay in position and give thermal immunity. The margin of the tooth should be cut true and as nearly at right angles to the surface penetrated as the structure of the tooth and the cavity outline will permit, then *the inlay will butt the cavity*

margin, forming an ideal joint. This joint should be absolutely flush and well burnished. The margins of inlays should be accessible for convenience in working. Sharp angles at the cervico-buccal and lingual aspects of the approximo-occlusal fillings should be avoided. In occlusal cavities, the outline of the cavity should have rounded angles, to avoid the gold wearing away the corners in the investment at the time of casting. The cavities with narrow necks are apt to show that parts of the investment have been worn away leaving the inlay full at this point. It will not go to place until the neck is narrowed at these points.

Let us bear in mind that while we have mentioned many of the salient points in the technology of the cast gold inlay, which saves frail teeth and weak enamel walls, relieves patients of many of the nerve-racking procedures incident to the placing of the rubber dam, the condensation of foil and the tedious sitting, it alone does not constitute professional success. The profession of skill, brilliancy, honor, social position or the ability to get the nuggets of gold, do not spell success. It is the frankness of expression, largeness of heart, flexibility of mind, accurate perception of difficulties and true discrimination, that makes our continued, conscientious services benefactions of the race, and bring to us the appellation—Success.

DISCUSSION

Dr. A. C. Runyan, South Haven, Mich.: I am not an expert on gold inlays but I believe that they have their special place in dentistry.

I have done more or less of the inlay work both in porcelain and in gold. I find that, as the doctor says, a great deal of the success depends upon technique, and the more that we take pains with these little details the more successful will we be with the inlay fillings.

It is claimed there is no better filling than a cement filling,provided it does not wash or deteriorate, or become eliminated by the secretions of the mouth. Now that we can protect them with gold inlays, I think that they make a very much better filling than any other filling that we have, except the esthetic claim of inlay porcelain. Gold inlays are better than poor porcelain inlays. Porcelain fillings have a great many faults. We cannot use them at times where we can use gold, because of their friability; and I think for the back teeth there is no better filling than the gold inlay, properly put in.

Dr. Lanphear: I wish there had been more discussion on this subject.

There were several important points that I wanted to see brought out in the discussion. I have been interested in the work Dr. Price has been doing in regard to the shrinkage of the mold, and as near as I can find out he shows a shrinkage of about 15-1000 of an inch, which would make quite a deficiency in a filling. If we can get an investment that expands the space at the moment the gold is cast, and there is a shrinkage of the gold, though it is under pressure, perhaps it will be nearer the ideal filling. A good many operators have used the matrix system to aid in overcoming this difficulty, and they cast into the matrix, which becomes part of the inlay. The wax is built to perfect contour and the casting process causes a very slight distortion. With this method, I think, there is nealry perfect adaptation.

LIMITATIONS AND USES OF THE GOLD INLAY

By H. M. Semans, A.M., D.D.S., Columbus, Ohio.

We have passed the experimental stage so far as the uses of the gold inlay are concerned, and its limitations are controlled only by any other time-proven filling material that will suit, in the judgment of the operator, the necessities of the case.

This subject does not exact from me arguments against the use of gold inlays, rather I am expected to observe their already proven use while I try to show why and how and where their use is called for in filling tooth cavities. Please keep in mind that the older inlay, porcelain, at the hands of skillful operators has established itself not only as our ideal esthetic filling material, but that it is recognized as a most excellent permanent stopper, for thousands of such inlays are holding forth without carious returns about their environments. Also keep in mind that many more thousand gold fillings are still today showing to us that they are capable of perfect sealment of the cavities they occupy. And there are none of us but will give thanks to the persistent efforts of those few enthusiasts fifty years ago who by such efforts gave us amalgam, up to the present time our greatest posterior tooth preserver. Only a few years ago we had no other thought than that these two, gold and amalgam, placed properly against tooth walls, were par excellent, without limitation in the proper use of each in its place; in fact, nothing else was used except gutta percha and cement. But hold! like the crusaders of old I have found the talisman, cement oxyphosphate of zinc, once a temporary make-shift for frail teeth, cheap fillings, nervous, sickly patients, stopper of dressings, scorned by all as a permanent filling material, except by the occasional few who recognized an esthetic worth to it, even though constantly replaced.

It is hard to tell whether it was the solid block inlay idea of itself, or else something to help cement to be retained in a cavity, that has brought about inlaying of cavities; probably the groping about and working out of both ideas. However, today we accept the fact that inlays without oxyphosphate of zinc are as impossible as moon beams at high noon.

First, then, where are gold inlays uncalled for? In all cavities unlined with oxyphosphate of zinc. We all know that, only let us always keep it in mind. Next, in all the six anterior teeth which will warrant porcelain inlays, chemical porcelain cement, and gold fillings. We are now occasionally hearing the remark that porcelain inlaying has had its day. Yes, some kinds of porcelain inlaying has had its day, and most of us, no doubt, have helped some of our own and others' porcelain inlays to have their day, with a sigh and a-lack-a-day. But porcelain inlaying has improved so greatly, and bad results have taught us so thoroughly, that we know anterior tooth cavities which allow good thick edge approach of the inlay, where necessary, can be, and are, effectively and beautifully filled with baked porcelain. Chemical porcelain cements, while yet in an experimental stage, are showing, under wise and careful selection of the place, some very good results. All small cavities in anterior teeth which are not conspicuous and in many cases large proximal cavities which are more or less inconspicuous, do not call for the gold inlay. It is still good practice to fill such cavities with gold in the good old-fashioned way. The wide wedging and broad cutting away of tooth structure for inlays is not warranted. It would seem, then, that I have very nearly eliminated the gold inlay for the six anterior teeth; especially for esthetic reasons, they should not be used, if possible to avoid doing so. Yet under certain conditions a thin frail tooth, not having a great amount of labial sur-

face involved might warrant a gold inlay, with iridio-platinum pin and proper lingual preparation brace against stress and strain. We all see mouths with teeth more or less shortened, incisive ends badly worn down, the dentine between the enamel layers of hard to soft decay always connecting up with proximal cavities or leaking fillings; gold inlays indicated there? Yes, many times. Yet, ideally, what about the jacket porcelain crown?

The gold inlay with porcelain, baked or inlaid into it, as advocated lately, may work out to be a most excellent combination for anterior and some posterior restorations; if so, then to that extent do we remove a limitation.

Posteriorly, gold inlays are almost unlimited. The cost of a filling of course is a tremendous factor in our work, so I must immediately qualify that statement. Amalgam can be so quickly inlaid in almost all posterior cavities, and made very effective, so that it removes the necessity of gold alone as a posterior inlay. But we must remember that it is amalgam's cheapness over gold that gives it its great advantage. Laying aside wax fillings for leisure hour casting, or laboratory assistant casting, and the use of impression material with Price's stone cement models for subsequent filling and casting has given us great conservation of time. The ease with which amalgam is manipulated as against the labor and time taken to mallet in a posterior gold filling has cost almost all users of amalgam enough money to have bought and almost maintained that coveted automobile, or given an occasional trip abroad. In the minds of many dentists, gold malleted fillings used in the posterior teeth have become ancient history. Yet the gold filling can still and should be still used in most of the pit and fissure cavities. On the other hand, we can average up better contour and contact points with the gold inlay; our grooves, cusps, fossae and ridges can be perfect reproductions; the restoration of all frail and extensively decayed teeth is now almost universal; while as for ease and comfort to both patient and operator, there is no comparison. Gold inlaying, then, in posterior teeth, has wonderfully enlarged our field for better restoration.

We are constantly being told today that there is but one thing that stands in the way of inlays as our ideal fillings, and that is the always possible dissolution of the cement. This objection can be overcome in several ways. First, prepare the cavities right and obtain a correct inlay; second, set the inlay as Dr. Taggart tells us, with first a rocking motion so as to flow or rock out all the cement possible, followed immediately with firm, steady pressure for twenty or more minutes. A good inlay in a properly prepared cavity should almost, if not quite, eliminate the edge difficulty. But if it does not, and it often does not, then finishing bur burnishers will spin the gold over the margins. Lately we have been told that it is well to trumpet or bevel out more than we used to do, and this seems to be good advice. Our gold will burnish out or spin out under the dull bladed burs, polishing to a smooth nicety with disks and strips, as of old. Also we have lately been advised against the removal of quantities of our gold, both to economize and to give place for cement to get into to help hold, following the line of argument that the closer our inlay walls approximate the cavity walls, and the less cement we retain, the greater is the power of resistance; and that sounds like most excellent advice and a scientific truth, for small and medium sized inlays at least.

Pure gold seems to prove itself by all odds our best material, with 22k. plate a second choice. Pure gold has proven itself to be so much stronger and better able to withstand stress and strain than was expected of it.

Dr. Price's use of stone cement models to cast into has given us a splendid way to obtain perfect proximo-cervical enamel edge adaptations, and very much of the trimming can be done before placing in the tooth.

We are all quite familiar with the lamentations from some dentists over the fear that operators would soon lose their skill and cunning because of the fact that there will be much abandonment of gold fillings in favor of the inlay. Feared as much myself. But while delving lately into some old magazines, I was very much entertained over the fears of the old regulars that the new fandangled material, cohesive gold ("works just like putty"), as against the continued use of gold foil (non-cohesive) would entirely eliminate skilfulness and manipulative ability from the dental profession. No, indeed, it is going to take great skill and manipulative ability to place a perfect gold inlay, one that retains its seat immovably before cementing, except in the direction of its desired withdrawal, one that closes of itself the margins, one that will conserve the tooth for years, one that will restore the contact point so splendidly that there will be no "meat spaces" with the terrible concurring ailments of gum and alveolar tissue, one that will present perfect anatomical restorations of all its surfaces, one that will protect enamel walls from fracture, in fact, one that will do that which we most desire, save the tooth in an ideally practical manner.

THE GOLD INLAY

By J. V. Conzett, Dubuque, Iowa.

I want to commend the use of the gold inlay in its place, but it should be used with discretion, and to be successful must receive the same careful painstaking attention that is given to the gold filling. If this is done in every case, if the operator strives to make every operation better than the last one, there will not be a decline in his technical ability but he will go on from victory to victory, for "To him that overcometh shall be given the crown of life." I can not close without urging the profession, and particularly the younger members thereof, not to abandon the use of gold foil as a filling material. The older men will not. They know the value of it. But aside from its merits as a filling material, I know of nothing that will so perfect the technical ability of the operative dentist than will the mastery of gold foil. The man that can make a good gold filling has acquired a technique that will be of the greatest assistance to him in the mastery of any other material, and other things being equal, the man that has gained this technique will make a better operation with any other material than one that has not acquired it.—*Dental Review.*

CASTING GOLD ON PORCELAIN

By E. Cunningham, Perry Sound, Can.

At last I have been successful in casting against porcelain without checking. I use a flask, the dimensions of which are one and one-quarter inches in diameter and the same height. After coating wax with silex and plaster, I fill balance of flask with Brophy's imperial investment compound and after drying I place in a coal stove and leave till it is all red hot. Then it only takes a few minutes to melt gold and force home, and as there is quite a body of investment around the tooth, it has not time to cool before the gold comes in contact with it. I have made a four-tooth bridge by this method and all facings were intact.—*Dental Review.*

CROWN AND BRIDGE WORK

By J. H. Landry, D.D.S., New Orleans, La.

I have kept in touch with the best methods of crown and bridge work for twenty years and can enter with perfect propriety upon a discussion of the exercise of prudence in the application of the principles of crown work and bridging of spaces.

I do not propose to criticise or pass judgment upon methods that are freely used by others.

The very minutest detail of mechanical construction will not be given, feeling such to be unnecessary and I will deal with the broad underlying principles that govern the attachment of a foreign substance to a root in the mouth as a substitute for the lost crown, and the attachment of one tooth to another to support substitutes for the missing ones, calling upon them to perform duties belonging to the full membrane.

The experience and success of so many years has given this class of work the acknowledged right to be considered among the most useful and reputable operations of today; but the question arises, what has been the effect of its introduction to the dental profession for good or evil? Like most all advanced methods, its benefits up to the present time have been in restoring and preserving roots and broken down crowns of teeth that would otherwise have been lost, thereby improving the power of mastication, prolonging life and health.

How many times has there been a loss of good roots and teeth through improper attachment for the purpose of withstanding a strain they were unable to bear, by injudicious fit—or badly fitting bands, causing irritation of the peridental membrane?

A perfect crown must provide:

Firstly—A natural appearance if for the anterior teeth.

Secondly—A Richmond or preferably a crescent band to guard against splitting weak roots.

Thirdly—The fit should be perfect so there can be no dislodgment.

Fourthly—To preserve the interproximate spaces and guard against all irritation.

Bridge work embodies all the foregoing dangers, increased proportionately to the greater strain it is called upon to bear.

The collection of particles of food or other decomposable matter between the ridge or under the gum may be avoided by making the surfaces and interspaces self-cleansing.

The Logan, Bonwill, Howe, Davis, White and all other porcelain crowns that are used have certainly the advantage of a more natural appearance for the anterior teeth, over a plate tooth backed by metal. Of the ready-made crown I consider the Logan less desirable owing to the shape, size and weakness of its pin, which has been the cause of many split roots.

Noting the value placed upon a band for the security of the crown to root for so many years, is gradually passing to a crescent or no band at all, because we hear on all sides, "keep the neck of the teeth free from deposit of calculus or anything that might irritate the gums," and in the same breath we are told to "pass the bands up well under the free margin of the gum, regardless of such irritation."

Dr. E. Palmly Brown was the one who brought before the profession the system of porcelain bridges, anchored with gold fillings, malleted about a bar extending into the tooth.

Now the dental profession is greatly indebted to Dr. Taggart for his methods of casting gold inlays and for the attachment of crowns and bridges that will save the necessity of sacrificing the whole structure of many good teeth for bridging.

I very seldom use a band any more; it is unsightly, unnecessary, and with a good pin you will get all the strength wanted, as all the force is outward. Sometimes a band is necessary in a lower tooth where recession of the gums has left space for a very short pin to be used and a good sized band can be used and not be seen.

In preparing roots for crowns I always seal the apex before reaming canal for the reception of a pin and much future trouble will be avoided.

The dowel should be made of platinum and iridium wire only, all other kinds are not safe if subjected to much heat.

Before crowning a tooth always devitalize. Should pyorrhea alveolaris develop after a few years in that mouth, those teeth will be free from the disease while one sound one after another will be lost unless they are carefully treated.

I never take an impression for crowning of the anterior teeth; my patients' mouths are my true models, and besides saves lots of time. Get size and shade of facing ready before the appointed time of patient.

After reducing the root to the desired shape, take No. 33 gauge pure gold and burnish to the root, leaving it a little overlapping in lingual portion to burnish over root that will take the shape of a crescent band. Should you desire a large crescent band, fit one and solder to pure gold before burnishing same over root, then punch hole through plate and push pin to place, remove and solder (the pin having been previously closely fitted to the canal), replace same on root, reburnish to water tight joint and then trim to fit periphery of root. Grind facing to fit, back it up with No. 33 gauge gold, wax and attach the cap in mouth, remove crown, finish waxing as you want it, box cutting edge and sides, invest and solder. When polished you have a crown which fits perfectly over entire root and in cementing to place a thin film of cement will be caught between the attachment but not enough to weaken the strength of your crown. An open-faced crown is not a good anchorage for a bridge, for the attachment to be any way weak will cause a failure.

It is almost impossible to lay down any set rules to follow, but I will mention a few cases where a bridge will do good service. In making a bridge of twelve or fourteen teeth it is necessary to have not less than four good teeth or roots, including the two cuspids and two solidly set molars, that will carry a bridge for good service. In this case the cuspids should be cut off and crescent crowns used, the molars should be devitalized and two gold caps made for the abutment.

In case where right central and lateral are missing, left lateral and first and second bicuspid out, I would make that bridge in two pieces by using right cuspid and left central to carry right central and lateral, left cuspid and first molar to carry two left bicuspids and lateral. In all cases a good bridge can be made from a cuspid to a third molar. The two centrals will carry the two laterals and the laterals the two centrals, and so on. A loose root, if properly treated, will get firm and strong again.

I will now touch lightly upon an important part to consider. In trimming molar teeth you should always have in mind what the shape of the tooth would be if cut across below the margin of the gum. The barrel shape entirely taken off to nearly one-sixteenth of an inch below the gum line leaving the sides of the tooth parallel

so that the band will hug the tooth tightly. Take a lower first molar. The buccal side swells out very great, but the anterior surface not so much. After this tooth has been properly shaped it will be nearly square with the corners rounded.

In many cases after trimming the mesial and distal surfaces it will be necessary to trim only the lingual side, as the tooth often leans over towards the tongue, the band will pass over the enamel on buccal side and touch the tooth below gum margin.

The most difficult part to reach in trimming is the anterior surface of the lower molar. If you will take notice, an upper molar, when prepared, is found to be altogether different from the lower, being triangular in shape. This will sometimes vary, the palatal root being as broad as the two buccal roots, but not very often. A great deal must be cut from the mesial and distal surfaces of the posterior teeth and very little from the buccal and palatal or lingual sides. The cusps should be ground away, so a thick metal cusp can be placed on the band to insure a strong bridge.

HOLLOW CAST INLAYS

By W. S. Payson, Castine, Me.

In making a hollow cast inlay after the wax model is on the sprue, build up the investment on the sprue side and let it harden; then, with a small drill in the engine, drill out the back of the wax to the extent of the cavity wanted in the back of the inlay, and finish the investment.

The first investment holds the wax firmly. The drill is better than a lancet for cutting the wax. Particles of wax can be brushed away with a very fine brush.

A hollow inlay is more firmly held by the cement, and less gold is used.—*Dental Cosmos.*

AN ANTERIOR CAST BRIDGE

By E. Cunningham, Perry Sound, Can.

Prepare roots for abutments and adjust platinum caps. Pass pins through the caps and attach with solder. Take bite and impression; make model and grind facings. Remove pins and caps from the model and enlarge pin holes so the case will draw easily. Replace abutments on model and wax all facings in position, attaching sprue so that gold will not flow direct against the porcelain. The case is now ready to be invested and cast.—*Dental Review.*

TO HOLLOW OUT WAX MODEL FOR GOLD INLAY

By S. T. Neill, Clinton, Mo.

An appliance costing a trifle can be made in a minute or two. Remove the middle point from a hypodermic needle, hold it in Bunsen burner, and pull it out with pliers; slip a foot of rubber tubing over the large end of the needle, warm it in the flame; suck gently with the lips on the tubing, while holding the warm point against the excess wax of the model. Burn out wax in the needle point by holding in the flame, and blowing through it.—*Western Dental Journal.*

CASTING OF LARGE BRIDGES

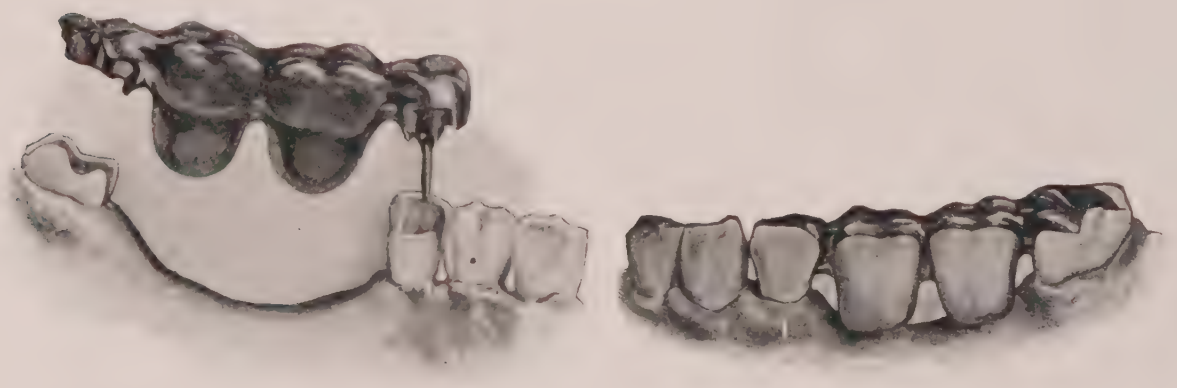
By W. H. Hayden, D.D.S., Youngstown, Ohio

Editor The Dental Summary:

Dear Doctor:—I have read with much interest all that I have seen in any of the magazines with regard to casting, especially bridge casting and other large cases. In the February SUMMARY I noticed a little item by Dr. J. G. Lane, of Philadelphia, saying that large pieces should not be attempted because of shrinkage and consequent misfit.

I have cast at least twenty bridges, of three to six teeth each, on two and three abutments, and two eight-tooth pieces on four abutments, one having eight facings, molding these in the mouth without impression or model, and I must say I never inserted as fine-fitting bridges by any other method.

Here is an illustration that may help readers to understand:



Description:—Two dummies, porcelain faced, anchored by an inlay in occlusal approximal surfaces of second bicuspid, with post in root canal, and distally by an inlay in a compound mesial and occlusal cavity in third molar.

Description:—Two dummies, porcelain faced, anchored by an inlay in occlusal approximal surfaces of second bicuspid, with post in root canal, and distally by an inlay in a compound mesial and occlusal cavity in third molar.

I would advise placing an iridio-platinum wire of generous size throughout such pieces, and a very convenient method of doing that, in such cases as that shown, is to bend the wire that forms the post in the bicuspid at right angles, and letting it extend into the cavity in the molar, thereby greatly facilitating waxing-up and carving. It, of course, adds great strength to the finished piece.

It is needless to say that I use the Elgin casting appliance, and cast directly onto the facings, the checking of a facing occurring so seldom as not to be taken into consideration.

MAKING A RICHMOND CROWN WITHOUT THE USE OF SOLDER—A DETACHABLE PIN FACING

By T. C. Hutchinson, D.D.S., Decorah, Iowa

My principal reason for recommending this method of making a Richmond crown to the profession is the simplicity of technic used.

A crown is a failure when it does not protect the root to which it is fastened against decay and breakage, when it is out of alignment, and when it is off color.

As is often the case, the dentist has not the shade required or the size needed in an all-porcelain crown, so he uses the nearest one to it and cements it to place; so I will endeavor to show that any porcelain facing or tooth can be used in the making of this crown. I will, however, describe the use of a pin facing and its detachable features. Other facings on the market can be used, following the same method, but in case of a Steele or Evslin, the facing is slipped off and the pin or the made-to-order facing is lifted out from its wax seat.

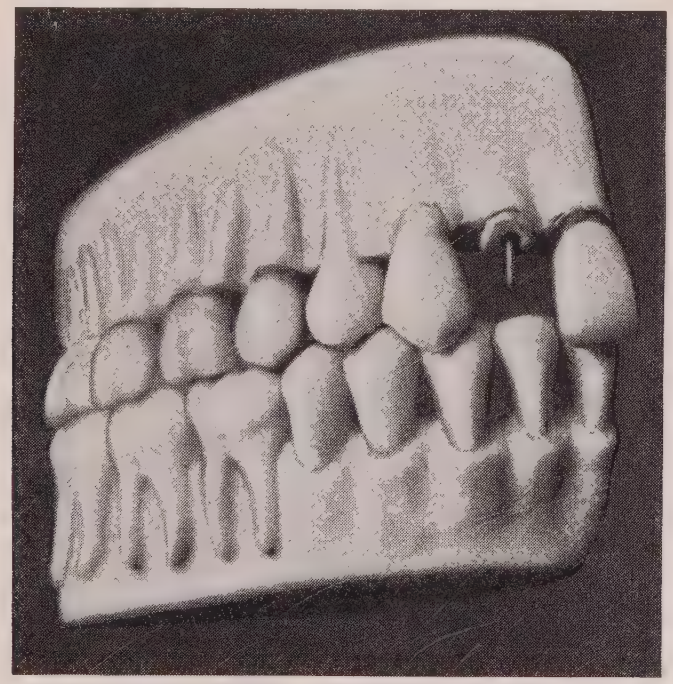


Fig. 1.—Root trimmed and post in position, ready for wax crown

Root Preparation—A banded root, when properly prepared is the surest and safest method of saving a root from decay or breakage, and should be used in all cases where the crown is to act as an abutment for a bridge, especially on single-rooted teeth.

Great care should be used in making the band snug fitting and without irritation to the soft tissues. A crown with coping of gold is much better than a poorly fitted band.

The root should be trimmed below the gum line on labial and palatal surfaces and left high in center; this prevents any backward or forward movement.

Fig. 2

Fig. 3

Post—In reaming the canal out for the post, make it just large enough so that the post will fit in snugly. Use Irridio-platinum; let it extend out of root about 1-16 inch, bend the part that protrudes palatally; then remove and melt a little solder to this point. The object of this is to insure a union of post to the cast gold. Use 16k solder, as this is a low fusing solder and the cast gold striking it will cause it to melt and thereby fuse with rest of crown. Note Fig. 1.

Facing—Select facing so as to match in color and size, and grind the cutting edge, so as to have the wax and finally the gold protect it. Fit the gum edge approximally, just so it extends to the gum line; then oil the facing on all sides, the pins especially, and select a mold on the Anterior Hutchinson Wax molding plate and place facing in labial or buccal side of same; then pour the wax in hot, but not too hot (wax which is too hot will absorb the oil which is to act as a lubricant and you will have a time removing facing). Another method is to soften the wax over a flame and press to fill mold with the end of a match or some other soft wood. After this take a hot spatula and trim off the surplus wax; then remove. See Fig. 2.

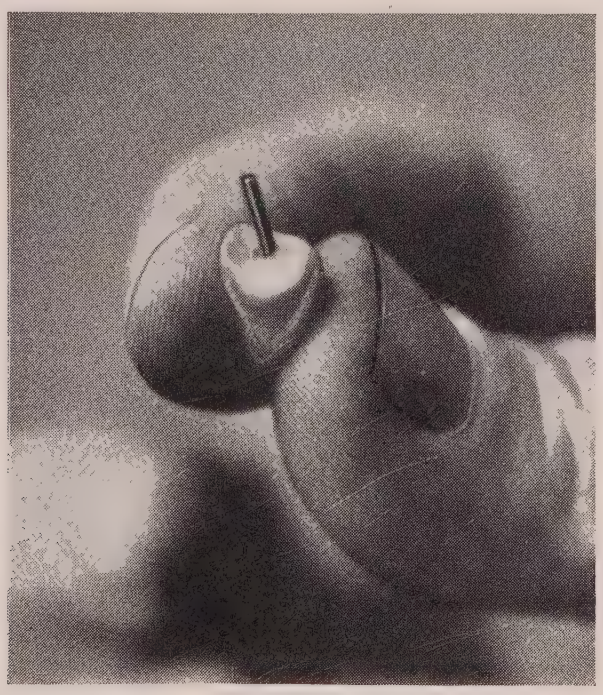


Fig. 4

Cool the wax and then hold between finger and thumb (Fig. 3) and heat that surface which is to be forced against the root and post. Be sure that the alignment is right, then cool and remove. Take an old broach (smooth), (Fig. 4) heat it and run it around the post to make it firm, and with a wax knife trim off the surplus wax around root impression, also around the facing; then put in place in mouth to see that no distortion has taken place (Fig. 5). Then remove and take a piece of sticky wax, soften and place against facing, removing it from its wax seat, and in the pin holes place the carbon points, which being the same size as the pins will go to place without any unnecessary forcing. Place the sprue at the thickest part of wax, invest and cast; after this is done clean and burn out carbon, and cement to place. The carbon points can be had from your dealers.

Very often we meet with cases where the bite is close and an ordinary facing is too thick, or we may have a case of an extremely small tooth to crown. I take any

vulcanite tooth, grind it down to fit so that you do not depend upon pins for retention, but make it just as you would an inlay for any single surface of a natural tooth. Oil it as above; in fact, go through the same procedure as described for the other facings.

DIRECTIONS FOR USING HUTCHINSON WAX MOLDING PLATES

Of all classes of work done by the dentist, there is none that gives so much comfort to the patient, and places the mouth in its most natural condition, as good fitting crown or bridge work. There is no line of work that advertises ethically, or brings the dentist in more cash than crown and bridge work. It has been the object of Dr. Hutchinson, in devising the Hutchinson wax molding plates, to give the dentist an easy means of accomplishing the best of results with the least amount of trouble. The making of crowns and bridges with the Hutchinson system has made it possible

Fig. 5

for the novice to do as good work as the most expert. In fact, it is a pleasure to do this class of work. It not only does fast work, but it enables you to do artistic, perfect-fitting dummy work. We also show you how to save gold; make lighter bridge work, yet stronger than by the old method of soldering. Many mouths have been ruined by having too heavy a bridge, which weighed down the abutting teeth, causing them to elongate and loosen, and finally come out. By the aid of the plates, you will find an incentive to talk crown and bridge work; you will do more of it, and the price of the plates, you have made over and over again by having had them. The dentist who is making the money today is he who has around him, in his office equipment, instruments which will aid him to do work faster, better, and with less worry to himself and patient.

The large plate contains one hundred and fifty-eight molds of the buccal and occlusal surfaces of the bicuspids and molar teeth.

There are molds of bicuspids and molars singly, and in pairs, and also molds of the bicuspids and molars united, so that you can get any desirable combination of the posterior teeth that may be required for any case.

The molds are perfectly smooth, and the arrangement is so perfect that you have an alignment of teeth which defy the most skilled carver.

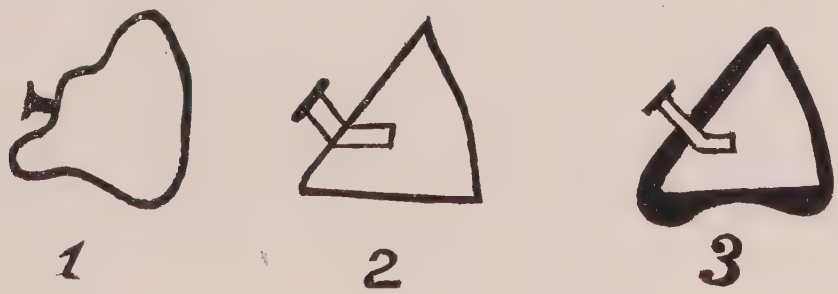
We have carefully selected and arranged a large variety of sizes, both in length of mold and also the width.

To reproduce a mold, be sure to oil the mold with a thin coat of 3-in-1 oil; then take a spoon and melt *base plate wax* and pour into mold; let it cool, then with a hot spatula trim off the surplus wax, and remove from mold.

Now, having your wax teeth and your plaster model ready, you can bend this wax dummy any way, and yet keep the forms, as made by the plate, perfect; you then adapt it to the model, getting the contour, holding the articulator closed, press the occlusion. You now trim off wax where needed, and take a minute amount of oil of cajeput, soft gauze or the like, and smooth all surfaces, and then your dummy is ready for the investment.

Be sure to use Hutchinson's wax or common base plate wax in conjunction with the plate. It is necessary to have a pliable wax. It burns out as well as any inlay wax.

To make a hollow dummy, oil the mold to be used, then pour the wax in hot, and while the wax is still in this heated liquid form, take a roll of absorbent cotton and immerge into said mold. The hotter the wax, the quicker the cotton absorbs, and the thinner will be the dummy. This will leave a uniform thickness of wax deposited in the mold. You can add more wax on the occlusal surface, where thickness is required. Then remove from the mold and adapt to your model and obtain occlusion as in solid dummies, then cast and solder a backing, or, if you don't want this hollow dummy, but wish it solid, yet you don't want the weight that an all-solid dummy



will make, nor do you want the gold expense that this large dummy would necessitate, *Listen! I will show how to get away from both of these objections and yet have a better dummy and a stronger one than though it were solid, and still have an all-gold appearing dummy.*

First, select a mold that suits your case, then oil it and pour it full of hot wax let cool and trim off the surplus, and then fit it to your model, trimming where needed. You now have the size and form of the dummy, which is to be used for your case. Second, oil the same mold again and pour the wax in hot, and with absorbent cotton suck out most of the liquid wax. Third, take an old vulcanite tooth having platinum pins (Fig. No. 1). Grind the surface off and bend the pins back as in Fig. 2. Now set in the mold, which has the thin film of wax, and press against the buccal surface, allowing for sufficient space approximately and occlusally; you then melt wax hot and pour into mold, covering completely the porcelain, leaving the pins exposed (Fig. 3). The object of having the pins exposed is to catch in the investment material and hold the porcelain in position, while in the act of burning out the wax and casting metal around it. If you were to cut this dummy after casting, you would find a box effect, which has proven to be as strong as though it were all solid metal. By using this method you are not only saving from one-half to two-thirds the gold which a solid dummy would take, but you are making a better dummy. One that is not over-weighted, not so ruinous to the teeth they are fastened to, and consequently one which will have more lasting qualities.

In a short time we will have for the market, porcelain cores with gold pins, so that after casting there will be no perceptible means of knowing where the pins protrude; until then you are at liberty to use the above means.

To make the backing for Steele facings, Evslin, or any detachable facing:

Place facing, after having ground to fit your case, and, having trimmed the cutting edge, place in a mold which holds it approximately, and oil both the facing and the mold, and pour the wax in quite hot and let it cool, and then trim wax off. You then adapt it to your model and obtain occlusion and trim off the overlapping wax, and leave enough wax for protection to the facing at the cutting edge; then with a piece of sticky wax heat and place against facing, letting cool a second, and then, in the case of a Steele or Evslin facing, slide off from wax. Place the sprue wire on the palatal surface of wax and invest and cast.

When using the pin facing, fit the facing and bevel the cutting edge towards the buccal surface, have the pins parallel, oil with 3-in-1 oil, and place in mold, and pour hot wax as above; let cool, trim off the surplus wax, adapt to model. You will note how much easier it is to obtain protection for your facing with wax than it would be with plate gold and solder. When you have perfected the fit to the model, trim off overlapping wax as above, and use sticky wax to remove facing; then in the pin holes place a piece of carbon point which is the exact size of the pins; invest and cast, and after casting, burn out the carbon and then cement to place.

THE ANTERIOR PLATE AND ITS USE

This plate contains mostly molds of the anterior teeth of various sizes and shapes, also molds of the full crown surface of bicuspid and molar teeth, and some extremely large molds of the bicuspid and molar teeth for dummy purposes. It is especially adapted where facings are to be used for crown work. There are so many features about this plate in the making of crowns and dummies, that it will be used often and become indispensable to the busy dentist.

THE CAST CLASP

W. B. Caldwell, D. D. S.

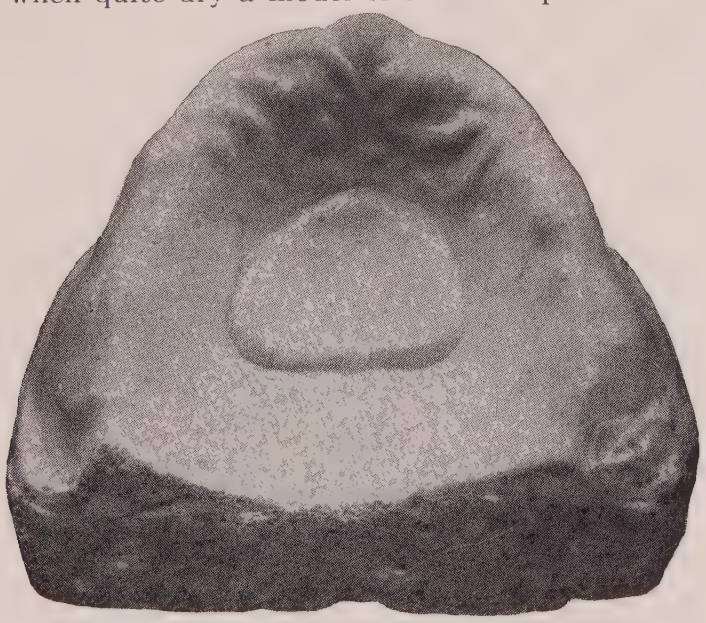
The cast clasp or band, used in retaining partial dentures, is found to be quite satisfactory, made after the following method: First, moisten plaster tooth to prevent wax from adhering, soften inlay wax and shape to desired thickness and width; press around plaster tooth as far as clasp should extend; (also, in cases where molars or bicuspids are to be clasped, and the articulation will permit, allow a spur of wax to extend over into the sulcus) by so doing the clasp will not allow the plate to settle, remove the wax after having shaped to suit the case, and invest as usual. If a lug is desired, shape and unite with wax clasp, cast in one piece.

Another Method—Take a separate impression of tooth to be clasped, pour a cast of plaster and XXX silex, equal parts, having cast prepared, melt inlay wax and paint it on tooth over area to be covered by clasp, then invest without removing wax from tooth. Care should be taken not to have clasp too thin as the cast metal is more liable to break than clasp plate. A partial denture constructed with cast clasps is very pleasing when inserted and quite practical, as there is no spring or rocking to the denture.

THE CAST ALUMINUM PLATE

By Robert Seymour, D.D.S., Philadelphia, Pa.

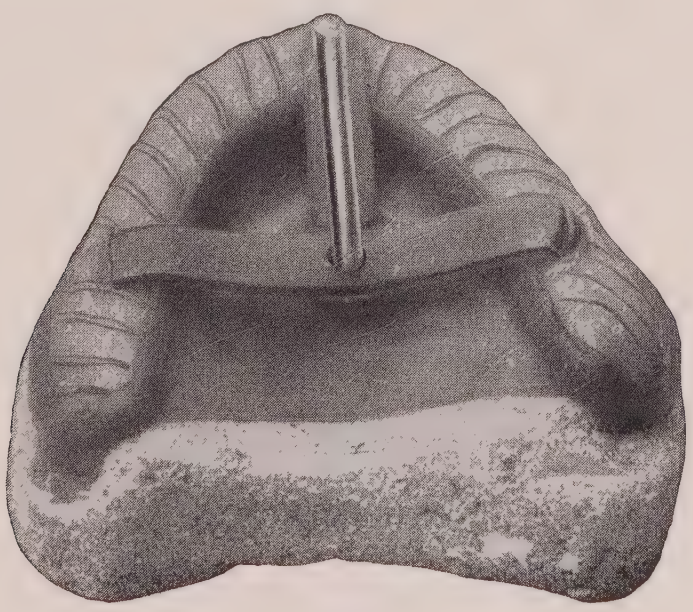
A plaster impression is taken of the case in the usual manner, and if a vacuum chamber or relief is needed it is cut in the impression. This is then given a thin coat of equal parts shellac and sandarac. When thoroughly dry an additional coat of sandarac varnish, when quite dry a model of silex and plaster in the proportion of



No. 1

three of the former and one of the latter is made, always taking the precaution to thoroughly soak the impression in water before running the model. (See cut No. 1.)

The silex I use for this purpose is a slightly coarser grade than that used for inlay investment. This will give a harder model and still produce a smooth surface



No. 2

on the casting. The plate is now waxed in the usual way, using tennax wax, as it is thinner than the ordinary base plate.

The following additions will be noted in cut No. 2:

(a)—Plate spurred or scored.

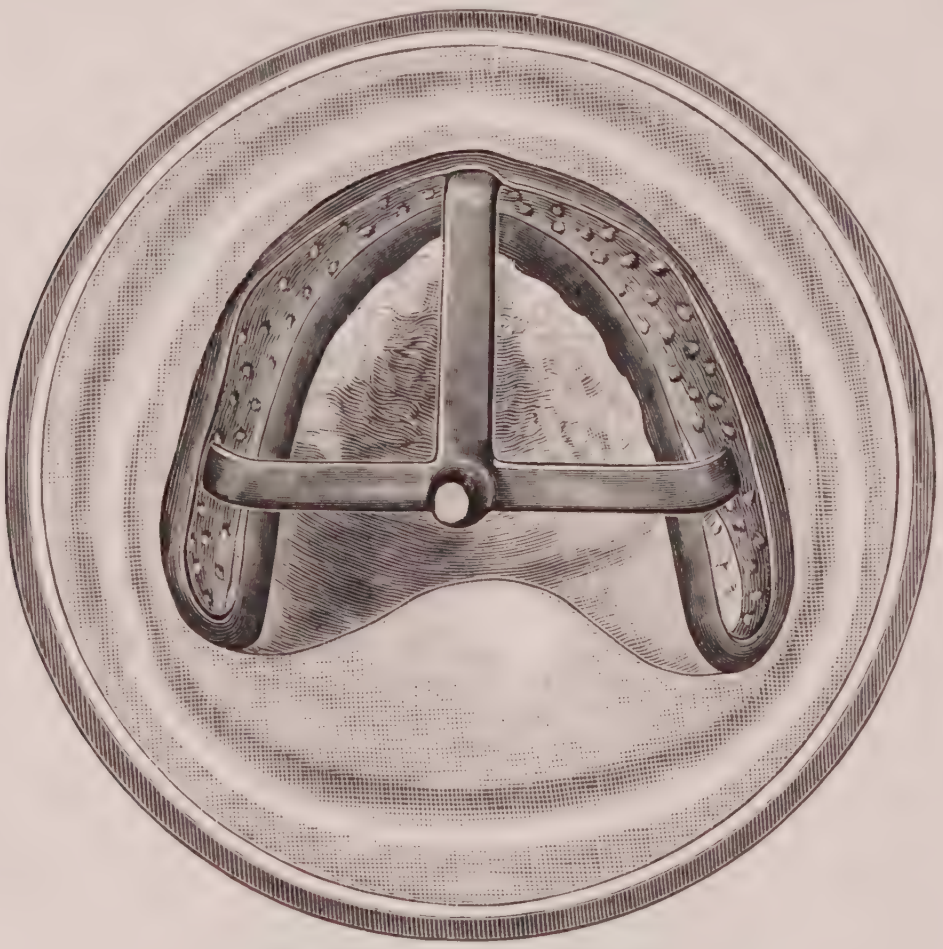
(b)—Wax rim inside and out.

(c)—Gateways.

(d)—Sprue.

The sprue may be a No. 10 wire as shown in No. 2, but we prefer a short wax sprue as shown in No. 3.

The plate being ready to invest, it is wise to place it in water and allow it to absorb all it will take up. The case is now invested in the lower half the same as an ordinary rubber case, bringing the investment to the edge of the wax. When this is properly trimmed place a V-shaped groove encircling the model a short distance

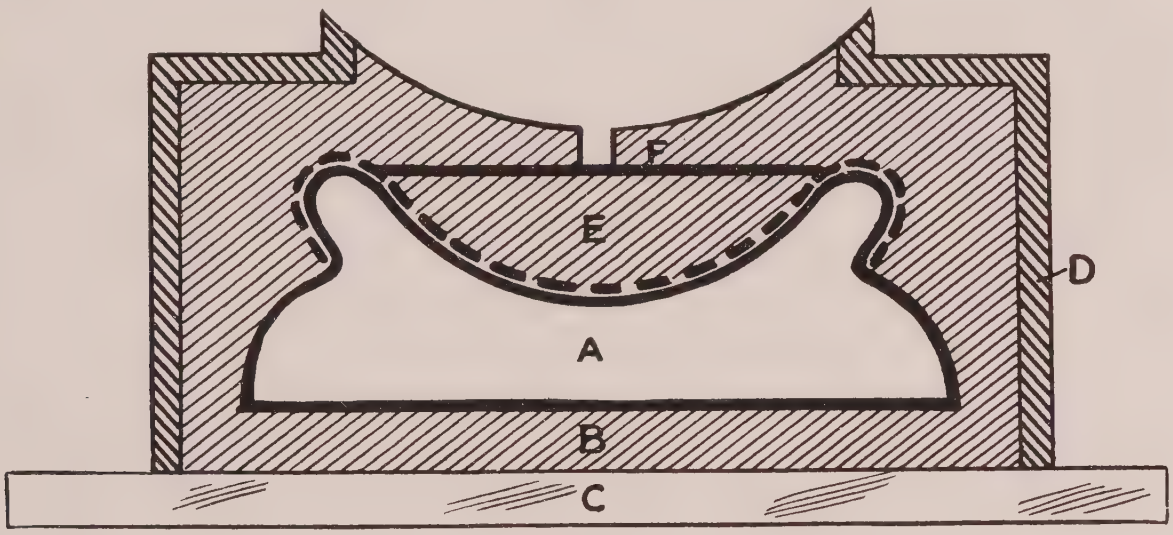


No. 3

from the wax. This surface is now given a slight coat with oil and afterwards brush lightly over with powdered soapstone; where the rugae surface has been transferred by means of tin foil, as in the case shown, this tin should also be slightly oiled.

The second half of the flask is now placed in position filled with investment, taking the precaution to shake it well to place; while this is still soft, a recess is cut away in the central opening of the flask, until the short wax sprue is exposed; this forms a crucible, for the subsequent melting of the metal. After the investment has become hard the flask is subjected to dry heat for a few moments and separated; the

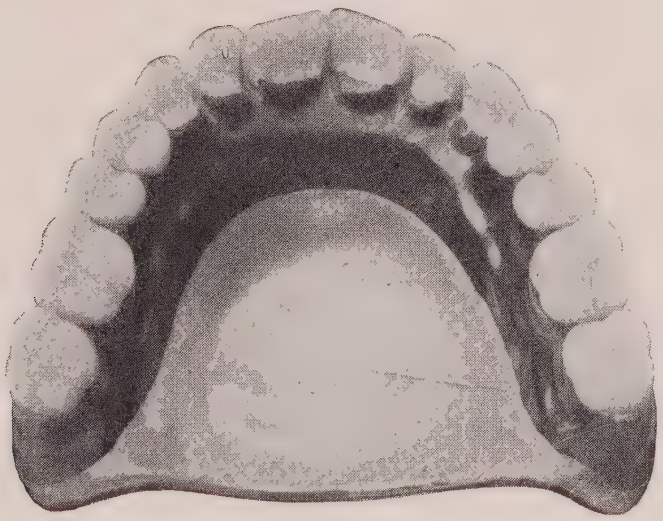
entire base plate of wax is readily removed and the only portion of wax left to be burned out is that contained in the gateways and sprue. The case is now heated on the furnace, and if any carbon is left on the surface of the model it can be readily removed with the blow-pipe, as the entire surface is exposed and has a great advantage over the closed flask method, as it is difficult to burn out such a large quantity



No. 4

of wax, and if this is not done the resulting cast is a failure. This is true in both systems of casting where pressure is placed directly against the molten metal, or the method of creating a vacuum.

When the case is hot, the upper part of the flask is again placed in position and it will locate itself by means of the V-shaped depression, which was cut in the first half, as the second half of the flask will have its counterpart. It also forms a guard to prevent escape of the metal from the flask.



No. 5

No. 4 shows a crossed section of case at this stage. The cup is now placed on the base of the machine, and the plunger cap placed firmly against it for the permanent adjustment of the flask. The metal is now heated in the recess prepared for it and when thoroughly melted the casting is made by packing moist asbestos fiber

in the plunger cap of the machine and bringing it gently, but firmly, against the flask. When the metal is cold, remove and cut away the gateways, leaving a small portion remaining to help retain the rubber. The teeth are placed by means of the rubber attachment.

The advantages of this method over the swaged plate are as follows:

1. Better adaptation, especially in undercut cases, as the case is cast direct on the original model.

2. It is stronger, as a rim is carried not only on the outside edge of the plate but also on the lingual surface a short distance from the teeth, the plate can also be varied in thickness according to the strain.

3. Better anchorage for the teeth.

CASTING WAX

By T. C. Trigger, St. Thomas, Ont.

I have been using wax in various colors, and find that a rose tint is more transparent than the green, which is a very essential point, as the marginal edges of the cavity can be easily seen and the thickness of the wax can be determined, over-lapping the marginal edges. To test the transparency of wax in various colors, I made thin slices of equal thickness, and found that the rose-colored transmitted the light more than the green, and the latter had to be cut very thin before any translucency could be detected.—*Dental Practice.*

TO OVERCOME WEAKNESS OF A CAST GOLD BRIDGE

By W. J. Montgomery, Chicago, Ill.

The brittleness of a cast gold bridge, due to the gold having been melted several times, may be overcome by sprinkling mercury bichloride over the molten gold immediately before casting.—*Dental Brief.*

COLLODION AS A SEPARATING MEDIUM

B. L. Worthley, Trenton, Mo., recommends collodion as a separating medium for plaster impressions. A single coat, followed when dry by a little soapstone rubbed over the impression, insures a clean parting and a smooth cast.—*Dental Brief.*

THE IMPRESSION METHOD FOR INLAY WORK

By Henry W. Gillett, D.M.D., New York City

Since the introduction to dentists of gold casting by Dr. Taggart, a large part of the dental profession has been concentrating its energies on the technique of the casting process. As a result many variations have been evolved and published. Prior to Dr. Taggart's introduction of the cast gold inlay, and antedating it by a period sufficient for many of us to have adopted it for constant use in filling cavities of medium and large size, we had the so-called matrix, or two-piece inlay.

When the cast inlay became possible, many operators who had been using the matrix inlay found it easier to adapt to the new process the technique they were already familiar with, than to develop the technique devised and so successfully carried out by Dr. Taggart.

This so-called indirect, or impression method, has been repeatedly shown at clinics, but I think it has not been as carefully described in our literature as it deserves to be. Because of this belief, I was easily persuaded by your committee to endeavor to present the merits of the process pursued by many successful practitioners, especially as it gives me an opportunity to urge upon you the need for, and the practicability of further advance in the perfection of this branch of our work.

In order that we may understand each other, I desire to say at this point that in speaking of gold inlays, or gold restorations, I have constantly in mind inlays or restorations that fit the cavity margin accurately at all points, and that reproduce, as far as possible, the anatomical features of the parts they replace. In my estimation inlays are failures if they show a cement line, lack approximal contact, or present smooth occlusal surfaces.

The type of inlay I shall have most in mind is the ordinary occluso-approximal of at least medium size, and from this up to complex restorations of whole crowns.

In order to direct your attention at once to the points I desire to emphasize, I will first enumerate some of the advantages which I believe accrue to the user of the indirect inlay method, and will then, at the risk of being tiresome, endeavor to describe in detail the steps of that method.

In conclusion I shall call to your attention the need for further advance in our technique with regard to reproduction of occlusal surfaces.

Among the advantages which I personally find in the indirect method are the following:

First—Superiority of fit and ability to use an alloyed, and consequently harder gold without interfering with this superior fit. My usual choice for inlays is an alloy of 97½% pure gold and 2½% pure platinum. In cases where greater hardness is desired, a higher percentage of platinum may be advantageously used, but the 2½% alloy presents the advantage of sufficient ductility to permit of the manipulation necessary to correct the errors accompanying the casting process.

Second—The fact that we have in this process a hard die or cast of the cavity on which this necessary correction can be done.

Third—The comfortable feeling that comes from the knowledge that if anything goes wrong in the casting process itself where it is less easy to guard against error, it is simple to start afresh without recalling the patient since the same die and occlusion are at hand, and will serve to make a dozen reproductions, if necessary.

Fourth—Opportunity for more perfect carving of anatomical characteristics in complex cases, and opportunity for finishing on the die, relieving the patient of all finishing in the mouth, except the final burnishing of the margins, and the slight polishing needed to remove the burnisher marks, thus conserving the time of the patient.

Fifth—The removal to the laboratory bench of all the carving and finishing at the hands of an assistant, and the consequent saving of the operator's time, and the enlargement of his capacity to turn off work.

It has been for some years my expressed belief that the same care and attention to detail by either the direct or indirect process would produce similar results. I have more recently come to feel that for all work except the conspicuously simple cases, the indirect process will average to turn out better results; that, contrary to the frequently expressed opinion the finished product is actually separated from the cavity by fewer steps conducive to error than when the direct process is followed.

It is generally held by advocates of the direct process that the indirect process introduces two extra chances of error in the taking of the impression and the making of the die.

Frequently we hear the claim made that the wax model exactly fits the cavity, and that the gold casting reproduces it with absolute exactness. Neither of these statements is generally true under the conditions necessary in our work.

The wax model necessarily changes in volume on being transferred from the temperature of the mouth to that of the operating room and again on being invested, the investment expands in the drying, wax burning and casting steps in a ratio usually unknown to the workman; worse still it often appears to warp in directions to which the workman has no clue except as supplied by the ill fit of the casting.

It is my belief that the errors in the taking of cavity impressions and those in making the die or duplicate of the cavity are more easily within the control of the operator than are those liable to occur at nearly every other step of the casting process—consequently I hold that when those two steps have been well performed the operator can, by the aid of the resulting die, correct most of the errors occurring in the subsequent steps and that his product will suffer less from errors influencing its fit. In short, I contend that until such devices as Taggart's Wax Warmer and Van Horn's device for maintaining body temperature during investment are obtainable, until investments are better understood, and the errors in their manipulation better guarded against, greater accuracy of fit will be possible by the indirect process than by the direct process, assuming similar conditions with regard to care and skill in both instances.

The description of the steps which I am about to give you will show you that there is greater chance of controlling error due to shrinkage of the impression material when taking the cavity impression than there is of controlling that of the wax model when made in the cavity because it can be better kept under pressure

and some of its shrinkage compensated for in the earlier stages of its cooling by forcing it further into the cavity. I think it will be conceded without much argument that we have amalgams from which dies may be made, which reproduce with but very slight error the form indicated by the impression.

I will now attempt to describe in detail the steps of the process.

Cavity Preparation—The only special point to note as different from any inlay cavity preparation is that in bell-shaped teeth it facilitates the work to cut back the approximal contour making a flat approximal wall. This is not feasible in many mesial cavities, but in distal cavities and others so placed that it will not result in undue exposure of gold, it permits the bringing of the approximal margins of inlays to the area of immunity with less sacrifice of tooth tissue and with less discomfort for the patient than if the whole cavity is broadened to the line of safety.

The impression of a cavity so prepared is less likely to be injured in withdrawal.

The Bite—The cavity being prepared, the next step in my own routine is to get a wax bite with sufficient accuracy to permit placing the die in it in its correct relations to the opposing and adjoining teeth.

If the die is inaccurately placed then the finished work will be wrong in contour, or occlusion, or both. Sometimes I take also a small impression of opposing teeth from which a cast is made for setting into the wax bite, and this is frequently the more accurate procedure, as it usually provides a more perfect reproduction of the opposing teeth than does the imprint in the wax.

In taking the wax bite, it is preferable to select a fairly hard wax so it will be rigid when cold, and thus stand handling when placing the die without resulting distortion. When taking the bite place the vaselined fingers of one hand each side of the teeth containing the cavities so as to prevent lateral spreading of the wax, and with the fingers of the other hand mold the wax first well into the cavities and then flatten it till the depth of wax into which the opposing teeth are to bite is reduced to the minimum required for the imprint of the desired portion of those teeth. If there is a large surplus of wax it tends to flow out laterally when the patient closes the teeth and thus distorts the impression of all the teeth included. Some patients can materially assist by maintaining closure and molding the wax against the teeth with the tongue while the operator does the same on the buccal surface with the fingers. Sometimes it is well to chill the wax before removal, but usually the surplus is sufficient to permit of its immediate removal without distortion.

Taking the Impression—Several materials are in use. The writer prefers "Perfection Impression Material" because it softens at a low temperature, and quickly becomes rigid on chilling. There are numerous variations of technique for getting the impression, but underlying all the desirable ones are two general principles. The first is that the impression material should always be so confined as to cause it to be pressed directly against all parts of the cavity, particularly all margins. The second is that the deeper part of the body of the material to be used should be firmer than the surface so that it shall serve as a support to hold the softer parts up to their required office, and as the whole mass is being cooled under pressure, to force the softer parts closer, if they tend to contract away from the surfaces of which an accurate imprint is desired.

This is accomplished in various ways. For short root ends, or for complex restorations where a whole occlusal surface, or more than three surfaces of a tooth

are included in the restoration, it is frequently desirable to fit a seamless band of soft copper, or other metal, proceeding as if to fit a crown band except to have it a little looser. When this is complete a block of impression material is formed to a cone shape, having its tip just soft enough so as to avoid stickiness, and is then pressed well home with the fingers, and kept under pressure while being cooled by a stream of cold water, or better, a stream of compressed air at 20 to 30 or more pounds' pressure. The latter plan is preferable to most patients because less irritating to other teeth, and it is neater.

With the opposite extreme in cavities—the simple four-walled cavity, just a stick of compound and an instrument to keep the gum away if it be needed, serves better than any cup, as the solid base of the block of impression material takes the place of the cup, and confines the softer portion.

For ordinary occluso-approximal cavities, cups made of German silver, platinoid or the Roach Impression Cups are preferred by many, and serve admirably. In using these cups it is important that after placing the material in the cup the whole mass be cooled and the surface again softened so as to provide for the hard base of material already referred to as essential to success.

I have left to the last the technique which I use most frequently, and which I consider best adapted to making sure of a well defined imprint of all parts of the cavity margin of occluso-approximal cavities extending to, or beyond the gum line.

Fig. 1

Fig. 1—Typodont with prepared cavities and matrix in position ready for impression of one cavity.

Selecting a piece of platinoid of 32 or 34 gauge a little narrower than the length of the crown of the tooth in hand, and long enough to permit of its being curved around so as to cover its lateral sides 1-3 or 1-2 way, I proceed to form a matrix by trimming the cervical side so as to impinge as little as possible on the gum, and usually cut the middle of its occlusal side in a curve with its depression in the center. This latter facilitates forcing the impression material well home as it does not have to enter so deep a pocket, and the curving around the sides of the tooth helps to confine the material and hold it to its work at the approximal margins. (Fig. 1).

This matrix is generally held in place with wedges of absorbent cotton tucked in between it and the adjoining tooth. If the shape of the tooth containing the cavity is such that any bit of impression material overlapping beyond the cavity margin is likely to be broken in the removal of the impression, then the matrix is wedged snugly against the cavity margin so as to avoid having such a surplus.

In this case the cavity margin in the die is formed by the angle of junction of the cavity wall and the matrix. If, on the other hand, the tooth shape is such as to facilitate removal of impression and surplus intact, the matrix is wedged less firmly into place so as to allow the impression material to extend over the cavity margin and insure an imprint of the surface of the tooth adjacent to the cavity as well as that of the margin itself.

The matrix being satisfactorily placed, a piece of impression material of appropriate size and shape is selected, and one end of it warmed and formed into a cone shape. The cone may advantageously have been formed in advance by assistants, thus conserving the operator's time. When softening and shaping the material, it is helpful to keep the fingers lightly coated with vaseline. Having the cone of compound softened with regard to its tip, and firm in its deeper parts, warm the outer surface of its base enough so the corners will not interfere with exerting firm pressure with the thumbs or fingers. Oftentimes I then stick the base while thus superficially softened onto whichever thumb or finger is the appropriate one for the case, and so carry it to position, pressing it firmly to place and guiding or supporting it with other fingers as may be necessary. Sometimes this forming of the surplus with the fingers is necessary in order to insure removal of the matrix with the impression. I keep pressure on the mass, and direct a stream of compressed

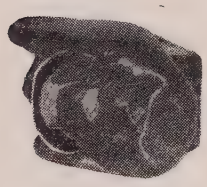


Fig. 2

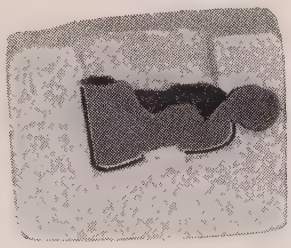


Fig. 3

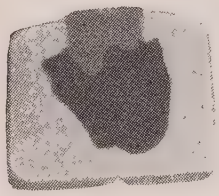


Fig. 4

Fig. 2—Impression of cavity with matrix in place.

Fig. 3—Section of impression and plaster investment as it would stand when ready for packing die.

Fig. 4—Section of a packed die before removing impression and investment.

air against the material, thus quickly chilling it. If the cotton wedges are accessible I usually remove them before unseating the impression. This is not essential, but sometimes facilitates removal of the impression without liability to fracture of important parts.

After the removal I immediately dry the impression with a stream of cold air, and examine it carefully with a magnifying glass to make sure that the imprint of the whole cavity and especially of the cavity margin is clear and accurate. (Fig. 2).

The patient is then dismissed, and the tray containing the impression, bite and card bearing the necessary instructions is sent to the laboratory. If there are no unusual conditions, I give the case no further thought until the patient arrives for the next appointment, at which time the inlay is tried in, its approximal and occlusal relations tested and perfected, if necessary, and it is cemented in place.

In the laboratory the first step on receiving the tray is to inspect the relations of the matrix to the cavity margin. If it has sprung away at all it is pressed accurately to place, a very little stick wax applied to its exposed side, and a bit of match stuck to it, the other end of the match being firmly imbedded in wax. This provides a brace that holds the matrix in place, and avoids risk of distorting

the impression, which would invariably follow if enough hot wax to hold the matrix were to be applied directly to it while under pressure sufficient to retain it in position. The hot wax would soften the material on the other side of the matrix, and cause it to yield under the pressure. Numerous other ways may be equally satisfactory, but this one is efficient and simple.

In the case of double compound cavities with two matrices in the impression a ring of stiff wire slit on one side may be opened enough so as to exert the correct amount of pressure when its ends are applied to the matrices, and a minimum of wax added at the point of contact.

Investment of Impression—The matrix being secure a quantity of plaster is mixed and at the moment when still soft enough to permit of so doing, and yet not so soft as to flow in and cover it, the block of impression material and matrix is pressed straight down into the plaster in such a manner as to leave the impression exposed at the bottom of the opening in the plaster made by the passage of the mass down through it. Careful examination is now made to see that no part of the impression is covered with plaster, and any irregularity in the sides of the hole or pit is filled in so as to avoid needless surplus in the die.

The result is a plaster block encasing the mass of impression material, except with regard to the surface bearing the imprint of the cavity, which lies exposed at the bottom of a hole of a depth equal to that desired for the die, and of a diameter approximating that of the crown of the tooth involved. (Fig. 3). As soon as the plaster has set the die may be packed.

Packing the Die—The hole in the plaster as described is the mold into which amalgam is to be packed to form the die. Select any good amalgam in sufficient quantity, and reduce it to a smooth plastic mass, such as is obtained by encasing the mass resulting from triturating in a mortar in a sheet of rubber dam and gathering the rubber tightly around it; or by dropping it into a rubber finger cot, and gripping that closely around the mass, and rubbing the resulting knob vigorously against the palm of the other hand. From the soft plastic mass thus obtained take a small portion and with rounded points and burnishers of such size as are adapted to the impression in hand work it carefully onto the surface of the impression, placing it definitely into all inequalities and small depressions.

As the surface of the impression becomes covered, larger amalgam masses may be used. Finally mallet force on a stick, which nearly closes the opening, heavy pressure with the thumbs, or with a clamp and rubber block may be used to consolidate the mass and expel surplus mercury. (Fig. 4). This work may be conveniently done late in the day and the amalgam allowed to set over night, but by using a quick setting amalgam the time may be shortened. When the die is removed from the impression, imperfections, if any, and surplus near the margins are carefully removed, and the sides of the base are given a slightly tapering shape away from the occlusal surface to facilitate seating and removal from the plaster cast. Usually if one or more dies are to be seated in the same cast, or if the base of the die is of a regular shape, a groove is cut across its bottom so as to indicate its seat in the cast, when working on it at a later stage, without need for trial.

The finished die is then carefully seated in the wax bite. In doing this observe any portions of wax that interfere, and trim them away until the die is accurately seated, depending upon the fit of such portions of the die as you know to be accurate for your guide on this point, and ignoring all parts where surplus has been

removed. Having seated the die and waxed it to place, select an articulator, preferably one provided with a lateral as well as a vertical hinge movement, and filling with plaster the portions of the wax bite on the side containing the die, mount it in the usual manner. If the imprint in the wax is to be used for reproducing the opposing teeth, that may be filled also and the mounting completed from the single mix of plaster. If a cast made from a separate impression is to be used it may sometimes be seated in the wax bite at the same time with the die

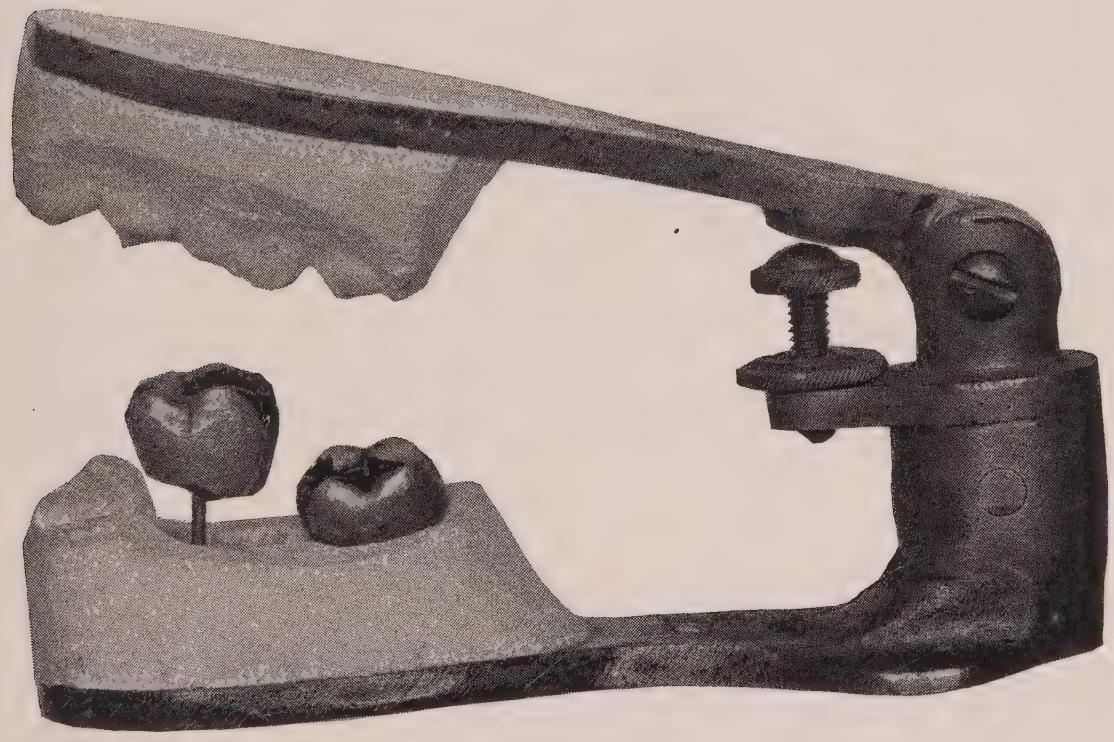


Fig. 5

Fig. 5—Dies mounted in casts on articulator. One die lifted out to show its shape.

or it may be seated after the cast containing the die is run and mounted on the articulator, and then attached to its articulator arm. When the wax has been removed, and the surplus plaster dressed away, the result is a replica (Fig. 5) of the conditions in the mouth that permits of free manipulation in carving the wax duplicate with no hindrance from tongue, cheeks, saliva, overlapping and bleeding gums, poor light, difficult access and nervous patient. The wax may be pressed into place

Fig. 6

Fig. 6—Example of pronounced cusp carving with round bottomed defective sulci.

with the aid of a matrix, and held under pressure until chilled, the die may be lifted out and all margins exposed to close scrutiny under direct light, the carving may proceed under the most favorable conditions, and at the hands of an assistant, who can, with training and practice, easily produce results in that particular line that excel in perfection the work of the average practitioner. For this branch of the work young women often prove very valuable assistants.

The carving being complete, the process of casting does not vary from that to be pursued in any casting, but when that step is completed the casting is tried in the die, all imperfections interfering with seating carefully noted, and removed, and the rough finishing performed first, then with burnisher and stone the margins are fitted with careful exactness, and finally the inlay, or restoration, is polished ready for insertion.

If the impression has been accurately taken, the die accurately made and accurately seated, the resulting inlay should go to place without any manipulation, and need only to be set in cement. If the contour or occlusion are not exactly right, it is very easy, having the die at hand, to place it in that and grind and polish as desired. The absence of grinding in the mouth is highly appreciated by most patients. For doing the polishing, wheels made from ordinary typewriter, or ink erasing rubber will be found most efficient. The ordinary round typewriter eraser, costing four cents, will make four wheels five-eighths of an inch in diameter, and when once used they become an indispensable adjunct in this work.

In complex restorations, where the whole top of a tooth is to be restored, the indirect process reaches its fullest fruition.

It is a great satisfaction to be able to remove a gold shell crown, whose fit is such that "sloppy" is a mild term for describing it, and on finding that the previous shaping has left the lateral sides intact, to replace it with a hollow case restoration supplying perfectly every requirement of a useful tooth and every mechanical requirement as to support without the need of a band encircling the root, to foster uncleanliness at the gum margin.

The men who can do in the mouth the required carving for such a case are exceedingly rare, and when such a carving has been completed, with the expenditure of much effort and patience, the risk of a slight mishap spoiling it, and the difficulties of perfecting its fit in the mouth after it is cast, are considered, it is removed from the list of feasible operations.

With the indirect process, however, such a restoration becomes almost as readily feasible as the filling of an ordinary cavity, and the perfection of fit and contour are sources of much satisfaction.

For complex restorations I frequently cast first a 24-karat base (Fig. 9) and fit it to the die, and then cast on it the desired platinized alloy. This results in a very perfectly fitting restoration since the pure gold base is easily manipulated on the die, and any desired degree of hardness is obtainable with the alloyed gold used for the rest of the casting. Usually my laboratory associate prefers to cast this platinized top separately, having formed the wax over the pure gold base in its seat on the die, and after so casting the top to solder the two together. (Fig. 10). In that case he uses one of the well known solders for which the formula has been given us by Dr. Fred A. Peeso. This solder matches so perfectly the color of a 2½% platinum alloy that when used to add a contact point, for instance, it can not be detected, after being well polished.

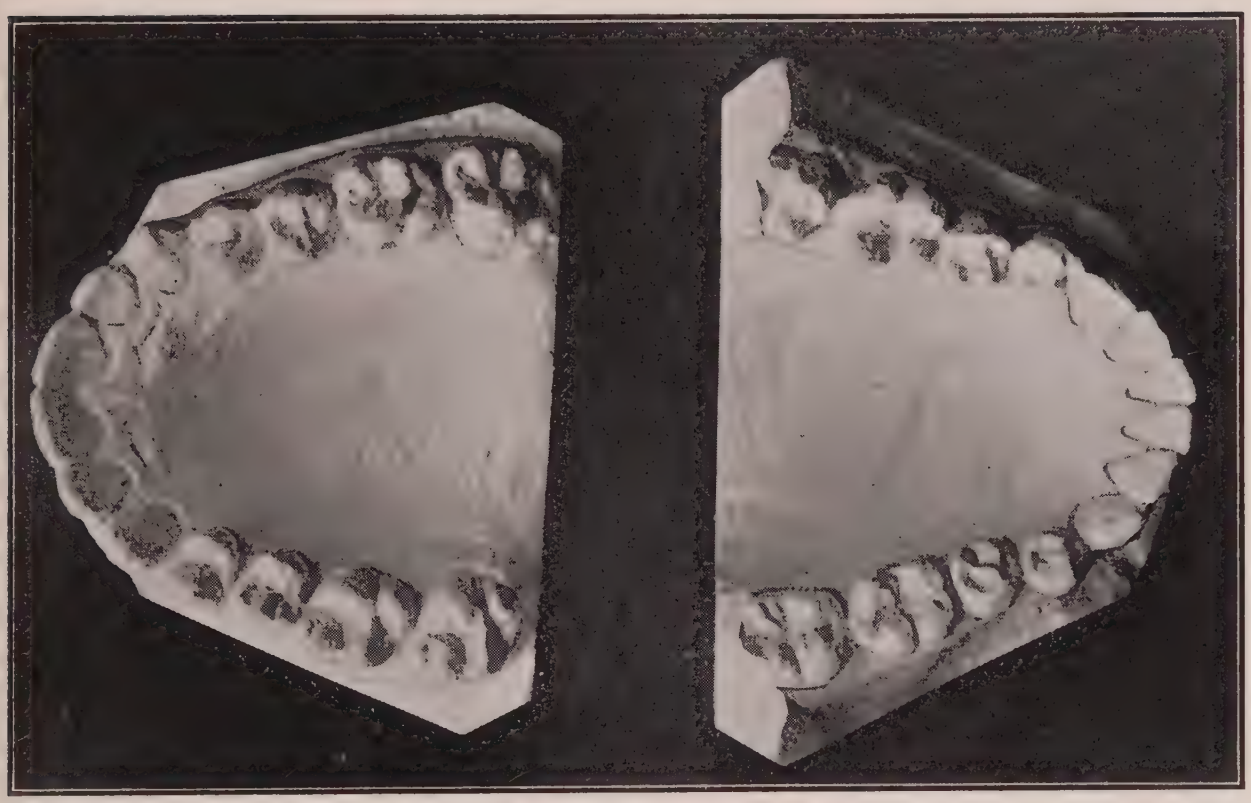


Fig. 7 (a)

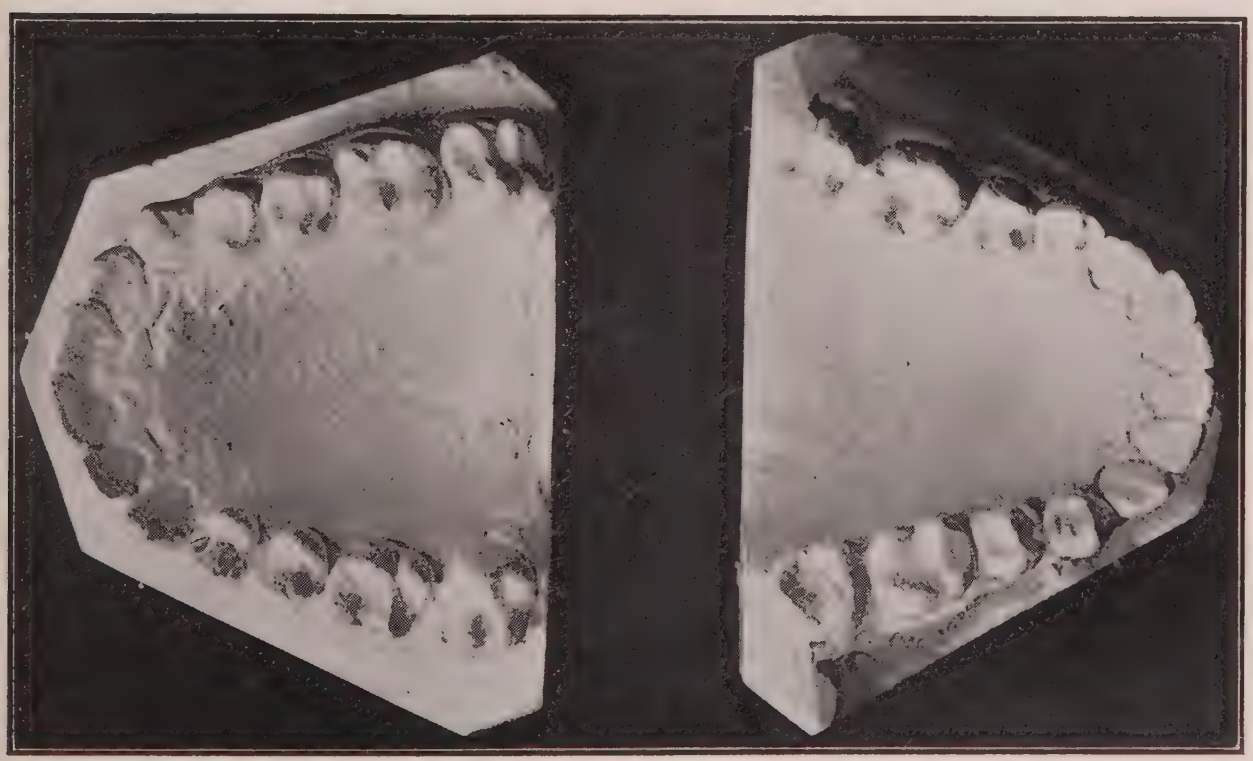


Fig. 7 (b)

Fig. 7—Cast from an orthodontia case of Dr. J. Lowe Young's showing normal condition (a) and condition after inlays were inserted a few years later.

As this solder is so readily made, and so serviceable, I give the formula here for the benefit of those not familiar with it:

Coin gold, 20k. solder; equal parts; fuse thoroughly on charcoal block and roll thin.

The melting point of the solder is high enough so ordinary 22 k. solder may readily be flowed on it.

Such complex restorations are of great service in restoring badly broken down molars, and with the addition of dowel pins they are frequently most serviceable as bridge abutments.

These steps seem long in the description, but if proper assistance is at hand, the process, as described, can be made to conserve the operator's time and enlarge his earning capacity. Intelligent young women make very satisfactory assistants for this work, and there is no part of it that they can not readily learn to perform.

It remains to be stated that in the case of the practitioner who does all this work with his own hands, there is doubt as to his turning out as much work by following the steps as described as by the direct process, but it is my belief that he will turn out work that will be of greater service to his patients. If that same practitioner will, however, take the needful time to train an assistant to do the routine steps that go on at the laboratory bench, he will find a material increase in his efficiency.

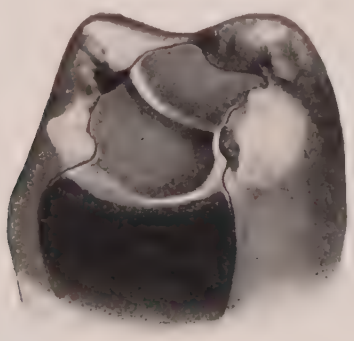


Fig. 8 (a)

Fig. 8 (b)

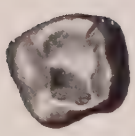


Fig. 8 (a)

Fig. 8 (a)

Fig. 8 (b)

Fig. 8 (b)

Fig. 8 (b)

Fig. 8—Illustrations of defective (a) and good (b) occlusal surface carving by courtesy Dr. J. Lowe Young and The Journal of the Allied Societies.

I now desire to call your attention to the need for further development of our technique in the matter of restoration of the anatomical features of occlusal surfaces. All the previous generations of dentists have been working by methods that did not permit, within the bounds of reasonable effort on the part of the operator, or of reasonable endurance on the part of the patient, of restoration of the sulci, ridges, pits and grooves of occlusal surfaces, and even the restoration of cusps was more often than not necessarily omitted. The resulting even-surfaced fillings served ordinarily to preserve the teeth, but not to preserve their full

function. Those of you who do orthodontia realize the imperative need for cusp restoration, and I doubt not that some of you have been asked why teeth with large fillings served so poorly as masticators.

At this point, with your permission, I desire to quote a few sentences from an unpublished paper by Dr. J. Lowe Young, read before the Academy of Dental Science, and to be published in "*The Journal of the Allied Societies:*"*

> "Did it ever occur to you that the orthodontist often works for years to build up this normal occlusion, only to have it pulled down in a day by ruthless extraction of a single tooth, or by the lack of restoration, by the general practitioner, of cusp contour or approximal contact in making fillings or inlays?
>
> "It would seem, therefore, that the dentist must share the responsibility of the orthodontist in emphasizing the importance of normal occlusion by preserving it at all times, and at least by not destroying it.
>
> "Hence, if the general practitioner is to properly restore any part of the dental apparatus, he, like the orthodontist, must have in his mind's eye the forms, surfaces and positions of the dental organs when normal.
>
> "The value of proximate contact, the proper occlusion of each cusp, the size of each fossa, and the direction of each sulcus, should be known to him who aspires to restore or re-create these anatomical forms."

For a time after the introduction of the cast inlay we were fully occupied in coping with the difficulties of technique, and the problems of marginal fit and anchorage. Now that these have become so well understood it behooves us to

Fig. 9

Fig. 10

Fig. 9 —Die and 24K base for complex restoration of molar with over-lap ready to be fitted to the die.

Fig. 10—Die, 24K base, and a 2½ per cent platinized cast cusps for complex molar restoration, the two latter ready for soldering together.

consider the fact that the casting process enables us to carve accurate reproductions of any tooth surface with but little extra expenditure of time, and to restore broken down tooth surfaces in a manner that shall leave them very close to normal in efficiency.

I confess, with regret, that my own development in this line has been slow, and I look back with sorrow to large occlusal inlays only two years old because they were finished in the sweeping curves of our earlier technique.

Later on I reached the point of full cusp and sulcus reproduction (Fig. 6) and realized that this meant progress, but cases that satisfied me six months ago I now regard with regret because they were so carved that the bottoms of the sulci could

*NOTE.—See June 1912, The Journal of the Allied Societies.

be polished, and this meant absence of the grooves and pits that belong there, and which play an important part in the mastication of food.

The cusps of opposing teeth should never reach the bottoms of sulci. If they do, there is much greater risk of splitting the tooth, and the absence of sharp grooves at the bottoms of the sulci mean lessened masticating efficiency. Compare Fig. 7 (a) and Fig. 7(b), also Fig. 8 (a) and Fig. 8 (b). Since we are now readily able to supply them, there is no longer a legitimate excuse for the absence of sulci, ridges, fossae, grooves and inclined planes from the occlusal surfaces of our inlays and restorations.

They may be carved into the wax surfaces with appropriate instruments, and gravers and burnishers of similar shape may be used for finishing if necessary, but such a surface as is left by the casting process, when carefully performed, with the anatomical features preserved, is of greater service to our patients than polished surfaces with those features absent.

A realization of this fact and the logical action on our part means that in the future a filled tooth will be as useful in performance of function as a sound tooth, and that our work will have mounted to a higher plane of usefulness to the world.

THE CAST GOLD INLAY

By C. G. Myers, D.D.S., Cleveland, Ohio.

At a dental meeting held in Texas several years ago, a dentist, in paying a high compliment to another dentist of some local reputation, said that he could mallet gold better than any man he ever knew. Though I cannot reproduce the word mallet in the southern accent of this dentist, this expression had at the time a very peculiar effect on me and I have remembered it very vividly ever since.

At this time I had been in the practice of dentistry but a short period and my ideals had been barely established. But it occurred to me at the time that if a man's ability to mallet small pieces of gold into a cavity of a tooth, and the necessary endurance to accomplish certain results along these lines constituted a great man in any profession, my ideals would have to be very greatly altered.

My experience, after a number of years in the practice of dentistry, has been that dentistry has meant the carrying out of too many minor and petty details so as to test to the utmost one's nervous and physical powers. We find that the productive life of a dentist is not so great as that of men in other lines of business and professions, and this is wholly due to the fact that a dentist is subject to little petty annoyances and details that have been wholly eliminated in other businesses.

When I attended dental college I was taught that the ideal point for condensing cohesive gold was the needle point and that the serrated point was simply an aggregation of needle points. We were taught at that time to use points with deep serrations. We were also taught to use gold in very minute particles. A mallet weighing eight to ten ounces was used in condensing these small particles of gold.

About this time I learned the use of non-cohesive or soft foil. This gold is manipulated with hand pressure and by the wedging process. Some men were very expert in the use of this form of gold and it not only saved teeth successfully, but it was also a great time saver in certain classes of cavities.

After using deeply serrated points for several years those of shallower serrations came into use.

About seventeen or eighteen years ago it occurred to me that if gold had the property of cohesion, this property was not increased by the use of serrated points, and I designed and used and continued to use for twelve years a perfectly smooth point for filling teeth with cohesive gold. In fact, I used these smooth points for seven years before anyone was found who filled teeth in this same way. It was only after a paper had been prepared on this subject for the Ohio State Dental meeting at Columbus, some years ago, that the discovery was made that the use of smooth points had been advocated by some dentist twenty years before and this was absolutely all that could be found in dental literature on the subject up to that time. At the meeting at which this paper was to be presented there was in attendance Dr. Bowman, of Columbus, and Dr. Heise, of Cincinnati, who were using smooth points exclusively in manipulating cohesive gold, and strange to say, from that time to this I have found no one pursuing this same line of practice.

In filling some inaccessible cavities with the smooth point it was my practice to burnish certain pieces of gold to the mass of filling and this in time became my practice throughout the entire filling.

A double-end amalgam instrument was converted into a burnishing instrument and all my fillings were introduced into the cavity by the burnishing process and without the use of the mallet.

By the use of any of the above methods a great number of details had to be perfectly carried out, for the slightest imperfection in almost any part of the work meant an imperfect whole.

At a meeting of the Northern Ohio Dental Society, held in Cleveland shortly after the discovery of the casting process by Dr. Taggart, Dr. Goslee, of Chicago, read a very interesting paper on this subject and presented some beautiful specimens of work.

The interest of the dentist, not only here, but all over the world, was aroused by this wonderful discovery. To show to what an extent dentists were interested in this process it is only necessary to state that within a very short time, after Dr. Taggart had given this process to the profession, more than three hundred applications for patents on casting appliances were filed in the patent office. Personally, nothing in dentistry ever appealed to me so strongly as did this process of Dr. Taggart's. As it appeared to be the emancipation proclamation, not only to myself but to all dentists, inasmuch as it eliminated detail and filling of tooth cavities. In a crude way this method was adopted in my practice and from that day to this I cannot recall a single instance where I have used gold in filling teeth by any of the older methods. And were I compelled to again resort to the practice of placing gold in cavities as we have been compelled to do in years past, filling teeth would be the last business that would appeal to me.

Modern methods in all lines of business, professions and trades have eliminated detail, but up to the past few years it was not thought possible to apply these modern methods to dentistry, but with the advent of cast gold, as suggested by Dr. Taggart, we have applied the process of elimination to our own profession.

Like all other innovations, cast gold fillings must run the gauntlet of the skeptic and the knocker. About the time that I took up the practice of dentistry, crown and bridge work was just coming into use and how it survived the many knocks it received at that time is more than can be figured out. It was claimed that it was unsanitary, unsightly and that the life of it was very limited. It was only when a dentist found his practice drifting away from him that he began to retract some of the harsh things he had said about it and added it as one of the means of extracting a livelihood from his profession. The same will be true of the cast gold inlay as was true of crown and bridge work. Some few will make a success of it and others will not because it is an apparently easy process.

The process is in its infancy, and the appliances are crude, as compared to what we will have in the future. Mistakes will be made, but through these mistakes will come ultimate success.

Let us look at some of the features of elimination brought about by this work. If it had nothing to recommend it beyond the fact that the teeth did not need separation, which I know from personal experience is a barbarous practice, it would need nothing more than this to class it as an ideal method of restoring lost contours in teeth. If it has eliminated the rubber dam, this alone would recommend it to the

helpless victim whose sufferings in the application of this necessary adjunct to the old methods of filling teeth were only equaled by the tortures of the inquisition.

Who has not suffered from the application of ligatures? Who has not suffered from having a sore tooth malleted upon until every blow seemed worse than the one previous and then the final tortures of the disks, stones and strips in the finishing process until dentist and patient were about as nearly nervous wrecks as they possibly could be?

No wonder dentistry and the dentist have been avoided. Even the dentist avoids the dentist. You will find in the mouths of dentists as bad a state of affairs existing as you will find in an equal number of patients. But a different state of affairs should exist today, through the methods we have of eliminating the sensation in the tooth and all of the disagreeable features formerly connected with the malleting of fillings in the teeth.

It will be but a short time when the demands of the patient will compel us all to use more humane methods in our work. The physician today who would attempt even minor operations without the use of some anesthetic would be classed as a butcher.

In regard to the technique I will have very little to say. As I said before, it is my impression that we have only a slight knowledge of the possibilities of this work and our methods up to the present time are very crude. I feel that Dr. Price with his pressure gauges and heat gauges is on the right track when it comes to getting perfect and uniform results.

Up to the time the cast inlay was introduced, large restorations of the tooth were very frequently made with amalgam or crowning. But it is now possible to save teeth in a way that crowning has to be resorted to only on rare occasions. As attachments for bridges where at one time extensive grinding of tooth structure was necessary or gold was unnecessarily displayed, we can now use gold inlays and gold overlays with pins running into the root canals as attachments for practically all bridges, and the resulting work is not only practical but substantial and beautiful.

For a great many years all-gold crowns made by me were made after the method suggested by Dr. J. Rollo Knapp, of New Orleans. The results obtained by this method were perfect for this class of work, but the number of details to be carried out was enough to discourage almost any beginner in this work. The same results or better results are now obtained through our knowledge of casting and with no more details than was required in the old shell crown. The construction of bridges both gold and porcelain at one time meant a multitude of details in its construction, but now with a few simple fittings a bridge constructed in wax with porcelain facings in place, a bridge of any size can be made in one casting and we have never made such perfect fitting plates as we have made by the casting process.

My method of making inlays consists in making a wax pattern of whatever is to be reproduced, investing this in one of the different investing compounds furnished by the dental supply houses, and using either centrifugal force or the vacuum for forcing the gold into the matrix. In casting directly on porcelain there is no more danger of checking the porcelain than there was by the use of the blow-pipe. It is only necessary that the temperature of the investment and porcelain be raised to the fusing point of the gold.

There are only two ways that the busy dentist can increase the income derived from his practice, one is by increasing his fees and the other by increasing his output

of work. It is very hard for a dentist with an established practice in a certain locality to very greatly increase his fees, but it is easily possible for him to more than double the amount of work turned out by using the casting process.

Now, I feel grateful to anyone who will put money in my pocket, and I feel doubly grateful to anyone who will make my business cares lighter. I do not feel that it would be fitting to close this paper without expressing my gratitude to Dr. Taggart for all that the casting process has meant to me in the last few years. If I am to continue in the practice of dentistry I can do so a greater number of years and with greater profits each year than I could possibly have done under former methods. Dr. Taggart is an originator and inventor and whereas he would like some substantial returns as a result of his inventions, for the inventor is usually an erratic individual and not a good business man, he would be more touched and pleased by the generous praise and plaudits of those in his own profession. It is not for me to say whether he is right in obtaining patents and trying to enforce legally what the law says is due him, but I do know that the dentists have made a very poor show of appreciation for the many benefits they have derived from what Dr. Taggart has taught them. Whether casting was known to the Egyptians or Phoenicians cuts no figure in this case. Dr. Taggart taught you what you know about this process and the chances are if it had not been for the energy, the sleepless nights and the outlay of money that Dr. Taggart has put in this work, we all would be plodding along in the same old rut.

DISCUSSION

Dr. L. E. Custer: Dr. Myers, after reviewing the malleted filling, first says it is quite unnecessary to separate the teeth for an inlay. This is true in all proximal fillings in teeth in normal position. That which was heretofore so hard to do is now one of the easiest parts of the work to produce—proximal contours in inlays—and in addition it has been my practice to melt a pin-head sized piece of 22-in. gold upon the contact point of the inlay, thus giving it a nicely curved surface of hard gold. That which was so hard to secure, and at the same time so important to secure, in a malleted filling, is now most easily produced in the inlay.

He correctly says that the rubber dam has been eliminated and with it the ligatures and the hours of painful malleting. I would also add that half of the pain of cavity preparation has also been eliminated, for as a rule the preparation of a cavity for an inlay does not require so much cutting in the dentine as for a malleted filling. A large part of the work can be done with the chisel and in the enamel. With the malleted filling the time was when the operations were feats of endurance on the part of the patient and dentist rather than of skill. But what a wonderful change has come about, not only in the humane methods of technique but in the final result. For who can deny that a cemented filling is not a better saver of teeth, a support rather than a strain upon frail walls, a preservative of color and one of less thermal conducting property?

The essayist is too modest in what he says regarding gold crowns. In my own practice the inlay has taken the place of fully 50 per cent. of the gold crowns formerly used. Sufficient time has now elapsed to test the merits of the inlay, and viewed as a method of practice, I regard it as the most revolutionizing step, all things considered, taken in dentistry in the past decade.

Dr. Henry Barnes, Cleveland: From the secretary I received a communication stating that I have had a large experience in cast gold inlay work, and requesting that I should discuss the paper. As a matter of fact, my experience has profited me nothing, for I have not succeeded to my satisfaction in this field.

There are those who claim success and I have seen beautiful work by this method. Not succeeding myself I reasoned that the thing for me to do was the thing that I could best do, so if agreeable to you I will briefly outline the method which I am using.

Before outlining the method, I desire to state that the cast method is in no wise condemned except so far as I am personally interested. Several months ago Dr. Alexander, of North Carolina, called upon me and outlined his method of packing moss fiber gold into a cavity, removing same, investing, and then melting 22k. gold plate into the mass. My cavity preparation was such that most of the gold remained in the cavity when attempting to remove the mass. However, thought was stimulated

and a gold matrix was placed within the cavity and this was filled with moss fiber gold (I now use Ney's No. 4 soft gold foil with equal success and a saving of time), the whole removed from the cavity, placed on the charcoal block and 22k. gold plate sweated into the mass, using the Lane blow-pipe and the mouth as a bellows. A little practice with this method will surprise you in the rapidity with which the work can be performed. Many cases can be made in the time required to make the wax model, and the margins are assured if your technique has been correct. To shape the gold matrix of 3-1000 pure gold, orange or other suitable wood is used, spatulate at one end and rectangled at the other, also another stick is used shaped at one end exactly as your grandmother used to notch her clothes pole; this serves to smooth matrix over the margins. Do not use metallic instruments on matrix except the matrix forming instruments at the cervical margins. Use no flux in sweating gold into fiber.

Question: How do you get occlusion? Answer: Fill matrix to occlusion and at the last use a little flux over occlusal surface, including matrix margin, then sweat 22k. gold plate over same. No flux is used previous to this time.

Question: Do you condense the fiber gold? Answer: Only as much as can be done by the hand with the wood point and to the anatomical form. If you fail to obtain a good cast inlay grind margins, place matrix in cavity, cast in this, remove and sweat 22k. to cast and matrix.

Dr. H. C. Kenyon, Cleveland: From the tenor of Dr. Myer's paper we naturally conclude he is an inlay enthusiast. And while I agree with much he has said, I cannot subscribe to all of it.

The first thing I want to take exception to is this:

"In a crude way this method was adopted in my practice and from that day to this I cannot recall a single instance where I have used gold in filling teeth by any of the older methods, and were I compelled to again resort to the practice of placing gold in cavities as we have been compelled to do in years past, filling teeth would be the last business that would appeal to me."

Unless his practice differs much from mine, I could not subscribe to such a statement as that. I do not believe that all the cases requiring fillings can be filled with inlays more easily than with some other kind of filling, especially the malleted gold filling. I believe there are some valuable things to be gained from the malleted gold filling, put in under intelligent present-day methods. I do not think that a statement like this should go unchallenged when we have young students in our audience who are apt to take statements of essayists as authority rather than opinion.

I want to endorse fully what he says in regard to the use of the inlay in the place of the crown. I do not believe the inlay comes to replace the malleted gold filling so much as it does some other operations. I scarcely use the gold crown at all now except in cases of bridge work, where I think an inlay may not be of sufficient strength to carry its portion of the stress. In such cases I still use the gold crown because I can get stronger support. The essayist has called attention to some very important points which ought to change the minds of those who are opposed to the gold inlay, and the cast inlay in particular. One is the question of separation of teeth and the elimination of the rubber dam. I cannot conceive of a sensible operator putting a large gold filling in a tooth that is subject to pyorrhea, and I cannot conceive of a humane man putting a malleted filling in the mouth of a very sensitive, nervous woman whose health is so poor that she cannot sit through such an operation without a case of nervous exhaustion. And I think the doctor is timely in calling attention to the fact that we are practicing humane dentistry as far as we know how. I think we ought to emphasize these methods, and that is one of the strong arguments in favor of the inlay method of filling teeth. There is much that might be said as to whether we should use the gold inlay or the malleted filling. A man might better make a gold inlay than a poor filling. If he is going to leave the cracks there at all it is better to have the cement in them than not.

Dr. J. V. Conzett, Dubuque, Ia.: I am diametrically opposed to some of the things that have been said, and I very much deplore the fact that any man will get up before a society of scientific men and say that he would not use a malleted filling in any place, because the inlay is a new process and the gold filling is as old as dentistry itself. We know what the gold filling will do, we have great hopes of what the inlay will accomplish, but I believe the man is very short-sighted who will cast aside the gold filling. Things have come and things have gone which were going to take the place of the gold filling, and from time to time men have advised us to throw away our pluggers; but the men who have done so have afterward been found sneaking around in the ash pile hunting for them. I want to condemn just as severely as it is possible to condemn, any man who will advocate the placing of inlays to the exclusion of gold fillings.

We deplore excessive extension for prevention. I advocate extension for prevention, but it should not be abused. You and I have no business to cut away tissue that can be saved. It may be that there are some men who ought to use cast gold inlays in every place, because they haven't the ability

to acquire the technique to make gold fillings. I do not believe Dr. Myers is that kind of a man because I know of the success he has had with gold foil.

I want you to understand that I am not condemning the gold inlay. I said in my paper that it had come to stay and I believe that it is going to have increasingly larger uses in restoring lost tooth tissue. But I do believe that the man who is going to be a good operative dentist should be able to use any material. It is a question of judgment; it is a question of technique; study the conditions and then employ the method which will best meet the conditions and restore the tissue to the best usefulness.

The doctor speaks of extracting a larger fee from our patients. I am glad I do not have to go out and rope them in. They come in. I do not believe that the men who are practicing dentistry as it should be practiced in these modern days have to go out after patients. I do not believe that the patients come to us with fear and trembling. Just last week I had a lady come to me who had some most abominable fillings in her teeth. If you had seen them you would have thought that the dentist had used no cavity preparation whatever. She came to me in fear because of the experience she had had. That lady was at lunch with my wife and she said it was a positive pleasure to have her teeth filled in my office. I simply mean by that that because of our modern cavity preparation and the modern methods of using instruments, it is not necessary to inflict the pain that was necessary years ago. I should hate to be a dentist who would have to consume three or four hours in making a malleted filling. I believe I would quit dentistry. I do believe when statements of this kind are made before scientific bodies that we should get the other side. I believe that if we were to wipe out the necessity for making the gold filling—that if the other methods were to take the place of the gold filling—it would yet be best for us to practice the methods of the technique of the gold filling in our schools for the perfecting of our pupils, because there is nothing that will so stimulate a student as the making and perfecting of one's self in the filling of teeth with gold foil.

A COMBINATION CAST CROWN

By O. H. Simpson, D.D.S., Dodge City, Kansas.

The all-cast crown has about as many objectionable features as either the seamless or cap and band crown, and it occurs to me that by combining the two processes a much superior crown can be made.

In the all-cast crown it is practically impossible to get band below margin of gum without an element of guess work; besides the band is apt to be clumsy and has little or no tensile strength, which renders it unfit for support of bridge work. If it were not for the fact that the seamless is less angular in form than the average cap and band crown, and the absence of the solder line, there would never be a seamless crown used.

The ease with which the band can be adapted to the root makes up in a great measure for the difficulty experienced in getting a graceful union between cap and band. If any extensive reinforcing is done there is always more or less risk connected with the process, and besides, it is difficult to get the thickness where it is most desired, and the solder is apt to shift at any subsequent heating of the crown.

Fig. 1

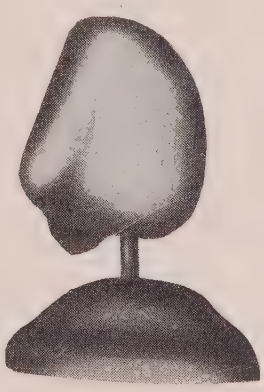


Fig. 2

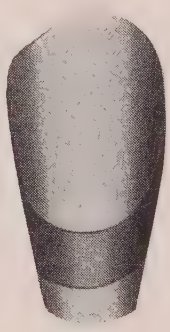


Fig. 3

Most of the objectionable features can be overcome by cutting the band wide enough to articulate edge of band with the opposing teeth. Place band on root, festoon and adapt band to circumference of root. The band is readily articulated with opposing teeth by having patient open and close the mouth a few times, thus showing where to trim away the band. Be sure to leave band on the buccal surface as long as the cusps of the adjoining teeth, as the distinct feature of this way of making a crown is, that the band and cusps are made continuous, doing away with the solder joint between cusps and band. The cusps can be made any length or form by cutting notches in band and contouring with pliers, as is shown in Fig. 1.

The band being longer it furnishes the operator a better opportunity to contour than the old style of narrow band. Place band back on root and readapt to proximal teeth. If it is a short stump, partly fill the open end of band with investment, leaving room for sufficient thickness of wax to make cusps of desired thickness,

Finish filling the band with wax and have the patient bite down to get the articulation. Carefully remove band, carve wax to correct tooth form, preserving in a measure the articulating surfaces made by wax on opposing teeth. Fill upper end of band after removing from the root with investment; insert sprue and proceed as with any other casting. See Fig. 2.

I believe that the advantage of this way of constructing a crown over the short band and cast cusps can readily be seen, as the gold used in casting is not always the same color as the band, and if there is any slight defect in the casting process it is less conspicuous, as it is underneath, instead of on the side.

I have found Fig. 3 particularly adapted to the support of bridge work on lower cuspids where the patient objects to devitalization and Richmond crowns. Prepare tooth as is shown in Fig. 4, cutting key seats and making sides as nearly perpendicular as the case will permit. Make band open front and back, making it

Fig. 4

Fig. 5

Fig. 6

fit snug at anterior cervical and sides. Allow band to gap open slightly on the lingual surface so that the keys and back will cast in one piece. Figure 5 shows where I have sealed or melted wax keys and wax back on dry band before forcing it down over prepared tooth. Wax will not adhere so readily to a moist band, hence the precaution to attach the keys and back before forcing it over prepared tooth. Carefully remove; insert sprue wherever it is indicated.

This band will greatly strengthen this form of bridge support, and is seldom noticeable in conversation. With care the gold at the side and cutting edge can be almost entirely concealed, as is illustrated in Fig. 3. Sometimes when the band is not sufficiently heated, or is too badly oxidized, the cast portion fails to adhere to band. For this reason, I advocate soldering the two together. The seam being so perfect only a small quantity of solder is required.

Figure 6 illustrates side view of band Figure 3 before wax back and keys are attached.

DESCRIPTION OF AN INTERESTING CASE RESTORED BY ALL-PORCELAIN BRIDGE AND BRIDGES UPON CAST BASES

By J. M. Thompson, D.D.S., Detroit, Mich.

During the last week of July, 1908, Miss A., a non-resident patient, presented for restoration one of the worst cases of broken down roots (which had previously supported their own and artificial crowns) that it has ever been my fortune to see. The necessities of the case and the fact that it would be of interest to others did not impress me sufficiently at first to warrant my making photos, models, etc., before beginning the work. It was after having an X-Ray picture taken to locate a missing cuspid that it impressed me as a remarkable case.

Figure 1, as presented here, is the X-Ray picture, and that it may be fully understood, the reader will simply assume that he is looking from within outward, and the description will be easily followed.

Reading from left to right, we find the first bicuspid the only natural crown in the upper jaw. Letter "a" shows a broken down lateral root supporting a crown

Fig. 1

Fig. 2

held in position by a twist of cotton. Letter "b" shows unerupted cuspid resting against apex of broken down central root. Letter "c" shows porcelain crown with dowel extending into central root, around which is a roll of cotton which retained it in the gum and tooth. Letter "d" shows right central, a devitalized tooth with an inlay set in one side of the root for the purpose of properly shaping the end so that a porcelain jacket crown could be fitted, the crown being shown in position. Letter "e" shows another porcelain crown also held in position by a twist of cotton, and letter "f" another held in by the same method. It is needless to say that the patient was somewhat of an expert in the wrapping of cotton around the dowels of these crowns, and two of them were so securely fastened that considerable force was necessary for their removal.

Figure 2 shows central incisor with cotton still in place, having been worn part of a day before the root was removed.

A bridge of three teeth was first made for the lower jaw (right side), consisting of a shell crown upon the third molar, a Davis crown upon a cast base, for the first molar, with a diatoric molar supported between them.

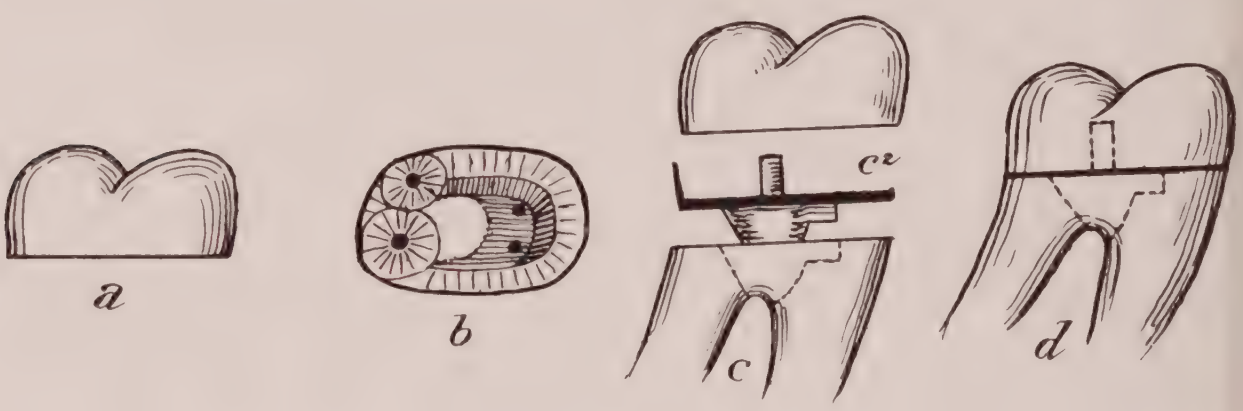


Fig. 3

The root of the first molar was of peculiar type (see a, b, c and d, Fig. 3), having three distinct roots with a perforation separating all three. The surface of the root was ground to a plain surface and a Davis molar ground to fit the tooth as perfectly as possible, and in shaping the porcelain molar it was necessary to place it in the furnace to restore the glaze. A piece of No. 40 pure gold foil was then burnished over the base of the crown and a post forced through the foil into the hole in the crown. The soft wax was then placed in position and the crown pressed down upon the root, the wax protruding through the perforation somewhat. This was trimmed off and again adjusted, and then removed and the porcelain crown taken away and a casting was made with gold foil in place. When completed, a very thin line of gold was all that would give any evidence of its being used upon a gold base.

Fig. 4

Fig. 5

A bridge for the upper jaw (right side) was then made, consisting of a Davis crown cuspid upon a cast base, a gold shell for the first molar with two bicuspids made by waxing the facings into place and forming dummies for casting and then removing the facings and using lead pencil points to preserve the holes for the pins. Thus we have a bridge without putting the facings through the fire.

Next the lateral, "e," Fig. 1, was removed and a crown of suitable size, shape, and color was placed in position. The porcelain jacket was then removed from "d" Fig. 1, and the root prepared with a facer and a dowel of iridio-platinum set in position to support one end of the bridge which was to be made. The lateral root, "a," Fig. 1, which may be noticed as in the place of the missing cuspid, was then prepared to support the other end of the bridge.

An impression was then taken and duplicate pins placed in the impression so that the work could be made upon the model and so constructed that it would draw with perfect ease. Four facings were then selected and waxed into position with pink inlay wax upon a base of one-thousandth inch platinum, which had been previously burnished over the model. New porcelain was then placed upon the labial surfaces of the facings at the cervical portion, also covering the platinum to quite an extent. This was then placed before the door of the furnace and the wax melted out, the porcelain holding the facings in their relative positions. No attempt was made at forming a foundation at this time, as it was necessary to form a block of four teeth before attaching it to either of the roots.

When they were removed from the furnace after the first baking they were again adjusted to the model and pink gum body laid over the first baking and the case again fired. Having secured the block, it was adjusted perfectly to the model, and having made a platinum foundation upon each root in the mouth, the block was then adjusted directly against the roots which were to support it. On account of possible change of shape, only one end was securely fastened at a time, and in this way a perfect fit was secured, and Figures 4 and 5 show the case before and after the work had been finished.

RESTORATION OF BROKEN-DOWN ROOTS OF BICUSPIDS AND MOLARS BY CAST METHOD

By A. W. McCullough, D.D.S., Pittsburg, Pa.

This method applies principally to bicuspids and molars, which are badly decayed or broken down, or where by accident, one cusp has been broken off, the break extending under the gum line, and a portion of tooth remaining.

First, after canals are placed in proper condition, pack space tightly with some good temporary stopping, and allow to remain a day or two. On removing, the margins will be exposed, and root can be shaped without injury to surrounding tissues. The root should be shaped in most retentive form, leaving a portion of remaining cusp for strength where possible.

Figs. 1, 2, 3, 4 and 5

A post may be used in canal, but usually its being so short, an impression of gold, making the whole in one, is advisable. After root is shaped, an impression of root with inlay wax, extending into canals, properly trimmed to margins, is now taken, invested and cast.

This assures perfect adaption to root.

Sprue is now cut off and cast, the part fitted into root, impression taken in plaster or compound, model made and selected tooth built into place with inlay wax; allowing it to extend over lingual cusp in sort of a hood shape to give strength and retention, and then carving occlusion to articulation.

Tooth waxed in position, model is then trimmed as small as possible, and invested again, put on fire and allowed to heat slowly, but to a high degree, so as to assure uniting to cast base and less liability of fracture to porcelain, and then cast.

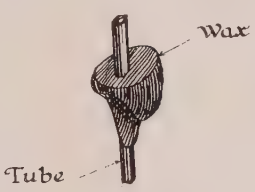
If model has been well shaped and smoothed, it will require but little polishing and make a very strong, esthetic crown.

SUBGINGIVAL AND ROOT CANAL RESTORATION IN CROWN WORK

By Edward C. Mills, D.D.S., Columbus, Ohio.

This method is offered to meet the requirements in those cases where the root has become extensively destroyed by caries and disintegration, and the root canal enlarged considerably beyond the requirement for inserting a dowel. To obtain free exposure of the end of the root, tightly press away the soft tissue with gutta percha, repeating the procedure at subsequent sittings, if necessary, as time expended at this step will greatly facilitate accurate adaptation (Fig. 1). After removing debris and decay, the sharp irregular edges should be carefully ground down with stones and a carborundum root facer. If sufficient portion of the edges remains, and it is desirable to use a banded dowel crown, proceed as follows:

Fig. I



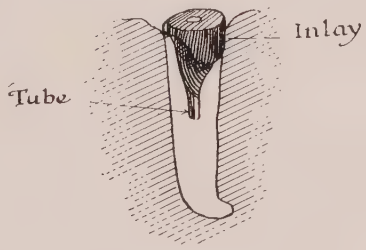


Fig. II

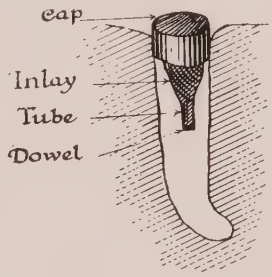
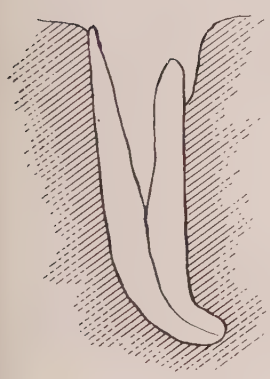
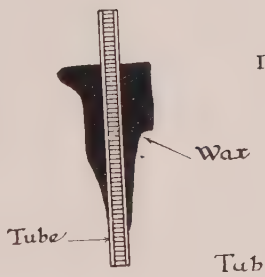


Fig. III





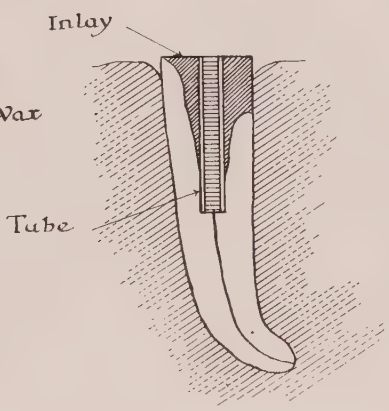


Fig. II

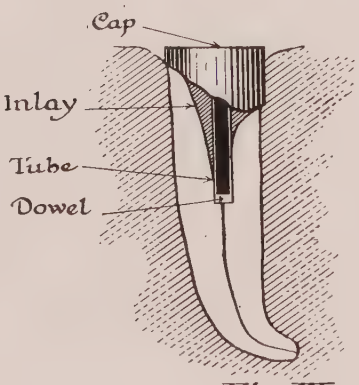


Fig. IV

Restore the root by use of inlay wax or modeling compound, carefully trimming and readjusting until the periphery of the root is re-established. Excess of moisture is then removed and this core secured in position by powdered gum tragacanth.

Measurement for the band is now made by using Barbour's No. 3 Irish flax,* the ends twisted until the thread is tightly adapted to the periphery of the root; then with a sharp pointed surgeon's shears the thread is cut closely as possible to the root. The advantage of the thread over a wire is the pliability of the former as compared with the springiness of the latter. After cutting, the ends can be brought

together and, if found to overlap, can be trimmed to a butt and an accurate measurement is secured. From this make the band of sufficient width so as to permit trimming, that a portion may extend to or slightly beyond the edge of the portion restored by the core.

After selecting a round or square dowel of surplus length, take inlay platinum, 1-1000 thickness, and wrap closely around the pin at least twice, making a sleeve, which is carefully slipped off and the exposed edge secured with a minute particle of solder. The sleeve is now readjusted to the dowel, correct gauge obtained and, with a bur of the exact size, the canal is extended to sufficient depth. The band is now placed in position, the dowel in its platinum sleeve is coated with sufficient inlay wax and pressed firmly to place, the wax is trimmed flush with the band and all carefully removed. The band is readily slipped off the wax and the dowel from its sleeve, leaving the latter extruding through the wax model, as shown in Fig. 2.

Place a piece of graphite coated with thin plaster in the sleeve, invest and cast (Fig. 3). After polishing, the excess length of sleeve is removed and the inlay thus formed placed temporarily in position. With the band previously made, the cap is completed in the usual manner, adapted to place on the root, perforated for the dowel at the proper point, and the latter is pushed to its place.

To sustain the accurate relation of the dowel to the cap, a piece of modeling compound is warmed and pressed against the projecting end of the dowel and surface of the cap, cooled with a spray of water and carefully detached. If the cap and dowel fail to remove, they are easily placed in their respective positions and secured by a speck of wax. They are now invested, being careful that the interior of the cap is filled with investment, and soldered (Fig. 4).

The cap with the dowel is now polished, and with the tubed inlay in position in the root, it will be found to pass snugly to place. The tubed inlay is then cemented permanently in position and, with the cap and dowel, the crown is completed in the manner desired.

In cases where a band is not desired or unavailable, due to the condition of the root, the inlay with the sleeve for the dowel is prepared at once and cemented to place.

This method of restoration reduces the amount of cement to a minimum and insures an accurate and determined position for the dowel.

---

*Irish flax is more economical and superior to dental floss in general use about the mouth. It can be obtained at any leather supply house.

PORCELAIN AND GOLD INLAYS

By A. W. Starbuck, D.D.S., Denver, Colo.
Superintendent of Infirmary, Colorado College of Dental Surgery, Denver, Colorado.

In presenting these articles upon porcelain and gold inlays, it is the desire of the writer to furnish an outline of procedure which has proven very satisfactory in his hands, as well as his many students'. He claims no originality to any of the methods, rather it is a collection of the good ideas introduced and practiced by the eminent porcelain and gold workers of the day.

The equipment recommended for porcelain inlays may be criticised by many owing to its simplicity. But as this is intended more for the practitioner who has been shut out from the use of porcelain owing to the extensive and expensive equipment supposed to be necessary, we will eliminate special instruments as much as possible, thus showing the possibilities using the ordinary equipment of general practice.

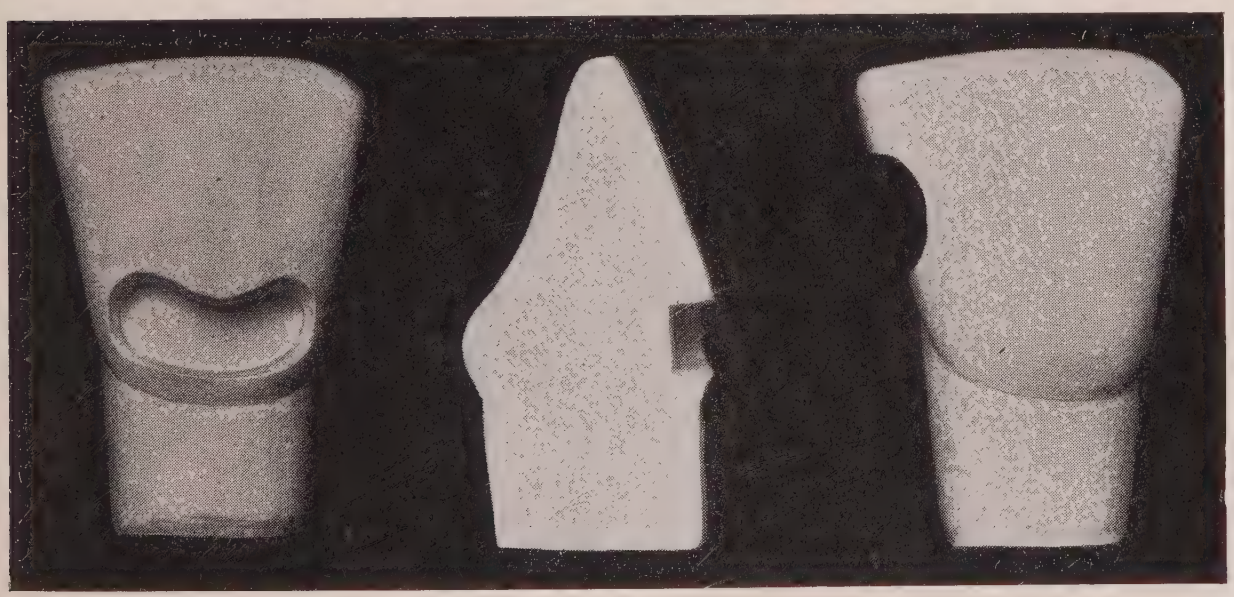


Fig. 1 Fig. 2 Fig. 3

CAVITY PREPARATION FOR PORCELAIN INLAYS

Generally speaking, cavities for porcelain inlays should be free from undercuts in the direction in which the matrix is to be removed. There should be flat seats at right angles to all possible stress from mastication. All walls should be as nearly as possible at right angles to the surface of the tooth. And all margins should be sharp and not beveled.

The cavities here presented are a composite of the good points gleaned from a careful study of a series of models sent the writer by about thirty of the prominent porcelain men from different parts of the country.

GINGIVAL CAVITIES

Gingival cavities should be extended only to include all the decayed area. In doing this, endeavor to get an oval or kidney-shaped cavity as it is extremely difficult to properly insert an inlay of circular outline. This extension is best accomplished by the use of chisels and inverted cone burs. In this class of cavities there are frequently several small pits on initial seats of decay. These are best united by the use of small inverted cone burs. Then with chisels break down the overhanging enamel walls. This operation should be repeated, first using the inverted cone burs (increasing the size each time), then the chisels until the cavity is extended to sound margins and symmetrical outline. After the desired outline is reached, any undercuts that may be present should be cut away and the walls made parallel by the use of square-end fissure burs, or better still, a similar-shaped plug finishing bur.

It is in these cavities we experience so much difficulty in securing a proper color, especially after the inlay has been cemented to place. Consequently great care should be exercised in getting the proper alignment of the margins, also proper

Fig. 4 Fig. 5

depth to the cavity. This being an extremely sensitive portion of the tooth many inlays are failures owing to a lack in depth sufficient to give enough bulk to the porcelain to exclude the influence of the cement, saying nothing of the strength of the inlay.

Many will criticise the use of the parallel walls, citing the difficulty of burnishing a matrix to a cavity of this nature. This objection you will find entirely done away with in the methods suggested later for forming the matrix for this class of cavities. The main objections to flaring walls are the lack of retention and the objectionable change of color in the inlay from cement. The nearer you can get this cement wall parallel to the line of vision the less it will change the color of the inlay.

A final inspection of the cavity should be made to make sure there are no irregularities or small nicks in the margins. This is best accomplished with the use of a lens. The marginal walls should be smooth, yet not polished, as cement will not adhere properly to a polished surface.

The writer can not recommend too strongly the plan of seating the patient in a normal position at this time and carefully viewing the walls of the cavity to make sure they are parallel to the line of vision, as this is so essential to the appearance of the inlay when set. How often have we viewed an inlay with pride when the patient was tilted back in the chair, only to be disappointed even to the removal of the inlay when the patient was standing or sitting in a normal position.

SIMPLE PROXIMAL CAVITIES

Among the many excellent ideas brought forth and taught by Dr. Black and his disciples is one point which, if possible, is of greater value to the porcelain worker than to the gold worker, and that is:

STUDY THE OCCLUSION

as the durability of an inlay depends largely upon the manner in which stress is brought to bear upon it. This one thing should receive our first consideration.

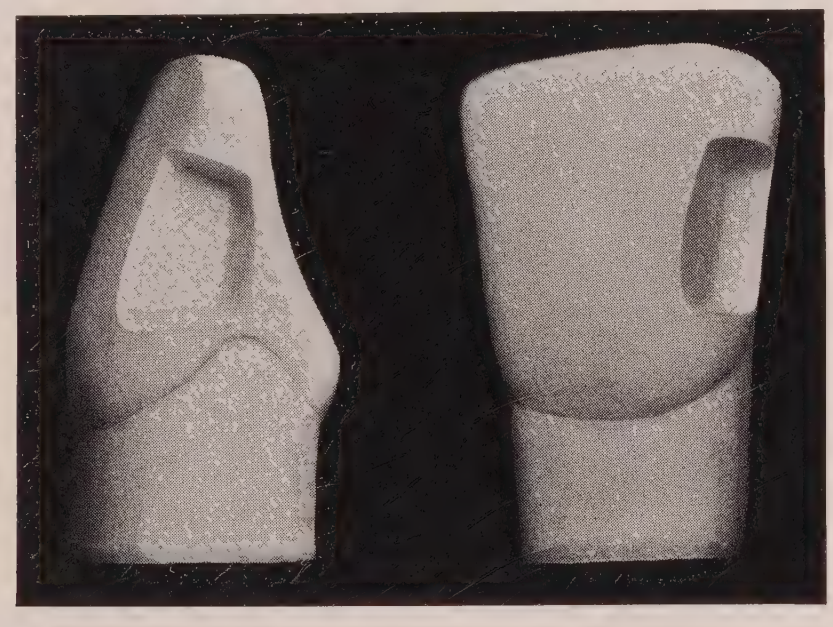


Fig. 6 Fig. 7

In cases where there is excessive stress porcelain is contra-indicated. However, in cases with moderate or ordinary stress porcelain will prove satisfactory, provided proper cavity preparation is considered and the inlay is carefully baked.

The patient should be requested to close the teeth, first, normally, then have him move his jaws in such a manner that every peculiarity of occlusion at that particular point can be carefully noted. Frequently what at first seemed a favorable case has proved dangerous when considering the lateral movements of the jaws. Many such cases may be improved by slight grinding of an angle of the tooth or the tip of a cusp when this portion is slightly elongated.

In inlays where stress of mastication is a factor of consideration they should always be removed in the direction from which such stress comes. There should also be flat seats antagonizing any force brought to bear from this direction.

Generally speaking, proximal cavities should be so prepared that there will be no difficulty in removing the matrix where there is but slight separation.

Fortunately, the lingual wall is generally the weaker, consequently it is a less sacrifice to cut away this wall to permit the easy removal of the matrix and this is

the logical procedure in the upper incisors and cuspids (the teeth we are dealing with mostly), unless we have an abnormal occlusion.

In preparing a single proximal cavity in an upper incisor, first break down the weak enamel walls, using chisels or hatchet and hoe excavators. Then with smooth, square-end fissure burs in the right angle entering from the lingual the cavity may be formed.

The cavity should be slightly larger at the lingual than it is at the labial to permit the removal of the matrix. The axial wall should be as nearly flat as possible and parallel with the long axis of the tooth. The incisal and gingival walls should be at right angles to this. These walls are formed with the sides of the bur, while the square end forms a flat seat under the labial plate. Any imperfections following the use of the bur may be remedied by the use of the hatchet and hoe excavators. All margins should be made at right angles to the surface and should be sharp and well defined. At this time the patient should be placed in a normal position and a close inspection made of the labial margin to make sure it is parallel to the line of vision, and if not it should be so altered as to remedy the trouble.

Fig. 8 Fig. 9 Fig. 10

It is needless to say that all remaining decay should be removed. In case this should cause undercuts or pockets they may be filled with cement.

The important points for consideration are: First, the cavity should be larger at the lingual than at the labial; second, the axial wall should be flat; third, the incisal and gingival walls should be at right angles to the axial wall; fourth, there should be a flat seat under the labial plate; fifth, all margins should be at right angles to the surface and not beveled; sixth, the labial wall should be so modified, if necessary, to make it parallel to the line of vision.

In cases where the lingual wall is strong and the cavity is near the labial surface the preparation may be so modified to permit the matrix being removed to the labial. This would be permissible only in very small cavities and those caused by an overlapping tooth and then when it did not involve the lingual wall.

The preparation of a cavity in a lower incisor, regarding the manner of removing the matrix, would depend largely upon the condition of the labial and lingual walls, but it would be preferable to remove to the labial.

In cavities of this class there has been considerable criticism by many as to whether porcelain was indicated in any case. However, time has proven that they will stand, under proper conditions, even equal to the average gold fillings.

Again, it is of the greatest importance to

STUDY THE OCCLUSION

This is something that should become a habit with every dentist. Very few men even think of the occlusion until the patient goes to leave the chair and com-

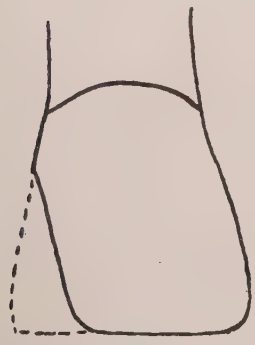


Fig. 11

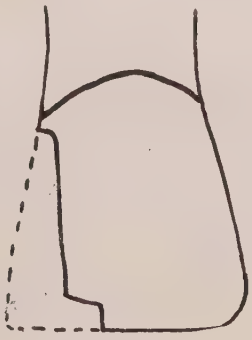


Fig. 12

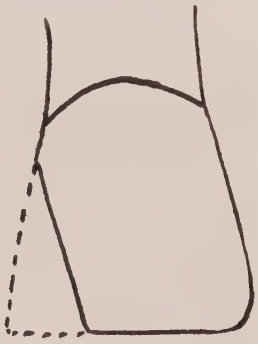


Fig. 13

plains of the filling or crown being too high. By carefully observing the occlusion on the start, it may prevent after disaster and possibly change the entire procedure.

In cases of an edge to edge bite and showing considerable wear, porcelain should be used with great caution, if at all. While teeth with normal occlusion may be filled with porcelain if due consideration is made of the preparation of the cavity and the results will be permanent and serviceable. In all cases we should endeavor to get the maximum thickness of porcelain possible. The method used by some of leaving the labial plate and building up the lingual plate only, at the incisal edge or vice-versa, is a dangerous and frequently disastrous procedure.

The method of cutting away the labial plate, (Figs. 8, 9, 10), to a straight line parallel with the long axis of the tooth and depending upon the depth of cavity and parallel gingival and incisal walls upon the lingual, has merit in cases where the tooth

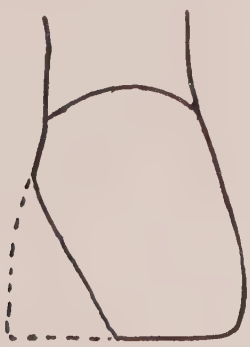


Fig. 14

Fig. 15

is of considerable thickness labio-lingually and there is sufficient depth of cavity in the direction of the pulp, but as a rule there is not sufficient anchorage to withstand the stress of mastication. The better method, and I think the one adopted by the

best authorities, is to gain additional retention by extending the cavity on the incisal edge, forming a step.

In shaping the labial margins, it is preferable to extend so all portions of the margins will either be at right angles or parallel to the long axis of the tooth. For example, if we had a tooth broken down as illustrated in Figure 11, it should be cut away with a carborundum stone until the margin assumes lines illustrated in Fig. 12, rather than shaping it as illustrated in Fig. 13, or again in a more extreme case as shown in Fig. 14, instead of simply smoothing the surface of the break, leaving the general view as it is, it is preferable to form a series of steps as shown in Fig. 15. A cavity thus prepared will show less and in many cases have increased retention. The principal reason for such a procedure, however, is the fact that the fine line of union takes on the appearance of a developmental groove, or a natural crack in the

Fig. 16 Fig. 17 Fig. 18

tooth and is hardly noticeable. An inlay that is a shade or two off in color will hardly be noticeable, while a bias margin is noticeable even with a perfect match.

The matrix should be removed in the direction from which occlusal stress comes; namely, to the lingual in the upper anterior teeth with normal occlusion. In all cases there should be flat seats antagonizing any such stress.

In preparing cavity Figs. 8, 9, 10, the labial plate may be formed with a knife-edge carborundum stone. The lingual plate is removed with chisels and hoe excavators; then with a smooth fissure bur extend and shape the gingival and incisal walls of the cavity sufficiently to permit the easy removal of the matrix. The axial wall should be flat and parallel with the long axis of the tooth and the gingival and incisal walls at right angles to this. The junction between these walls should be a well defined angle and not rounded as some advocate. With the end of the bur a flat seat is formed under the labial plate. Then remove any remaining decay and carefully inspect all margins to make sure they are sharp and well defined. Finally, seat the patient in a natural position and carefully examine the labial wall to make sure it is parallel to the line of vision from the cavo-surface angle inward. In other

words, only the cavo-surface angle should be in view. Especial attention should be given to the gingivo-labial angle, as it is at this point we have a tendency to cut insufficiently. A cavity of this nature is seldom indicated as it lacks sufficient incisal retention if there is any great amount of stress.

The method preferable and generally used is one where additional incisal retention is obtained by use of a step.

The main portion of the labial wall and the step are formed with a knife-edge carborundum stone. It will be noticed in Fig. 16 that the gingival wall of the step is not quite at right angles to the long axis of the tooth, but dips down slightly as it approaches the axial wall of the step. This is necessary to afford retention from dislodgment to the approximal as the fulcrum is at the cavo-surface angle of the gingival-surface; hence, the inlay in the step moves incisally slightly, if dislodged.

Fig. 19 Fig. 20 Fig. 21

By examining Fig. 17, it will be noticed that the line of the pulpal wall of the step is broken, thus affording additional strength to the porcelain at this point. This is formed with a small inverted cone bur held parallel to the long axis of the tooth. The diameter of the step mesio-distally should be about two millimeters ordinarily and about the same diameter inciso-gingivally at the narrowest point; or, in other words, should be of sufficient dimensions to give strength to the porcelain.

The main portion of the cavity is formed with a smooth fissure bur in the right angle. Special attention should be given to the gingival wall to have it at right angles to the long axis of the tooth, also to have a flat seat under the labial wall. Many advocate grooving this seat near the axial wall, but this is a very dangerous procedure as there is danger of cutting through the dentine to the enamel, which would completely destroy the strength of the wall, as there is no strength to enamel when not supported by dentine. Nor is a groove along the gingival necessary if that wall is perfectly flat and at right angles to stress.

Again inspect all margins carefully to make sure they are smooth and sharp and note the angle of the labial wall, especially the gingivo-labial angle in the main portion of the cavity and the gingival wall of the step.

If the labial wall is thin and lacks sufficient dentine to give it adequate strength, there should be an additional step made inciso-gingivally upon the lingual surface.

This is formed with an inverted cone bur in the right angle and should extend from the incisal step to the gingival seat. The step should be on an average about one and one-half millimeters wide and a corresponding depth. Some authorities advise a groove extending inciso-gingivally along this step, which has advantages in many cases, but care should be taken to consider carefully the location and size of the pulp in live teeth.

INCISAL RESTORATIONS

In considering cavities involving the incisal third of the six anterior teeth, it might be well to divide them into two classes: First, fractures; second, atrophied teeth.

In fractures, the teeth may be broken diagonally or almost at right angles to the long axis of the tooth. In either case, the labial margins should be cut at right angles to the long axis of the tooth. If the break does not involve both angles, as in Fig. 22, the margin should be cut away as shown in Fig. 23, or if the fracture is

Fig. 22 Fig. 23 Fig. 24

at a greater angle, the surface may be stepped, as in Fig. 24. This method of preparation will be much less conspicuous than where the margin is at an angle.

Porcelain "tips" are very disappointing in many cases, especially where they involve the entire incisal edge. We may have a perfect match for the color before cementing, and there may be no apparent change in the color of the porcelain after cementing to place, but the shadow caused by the tip and cement will cause the remaining portion of the tooth to turn dark and be decidedly unsatisfactory during ordinary conversation. If there is an approximal cavity which can be included in the restoration, this trouble does not seem to appear.

In large cases, involving more than the incisal third, it is preferable to follow the method suggested for badly atrophied teeth.

The retention for fracture cavities may be formed by cutting away the dentine to a depth equal to the extent of the fracture, as in Fig. 25, This extension for the retention is done with an inverted cone bur, followed with a smooth fissure and all walls should be parallel to each other.

In cases where there is danger of encroaching upon the pulp by using the above method, the procedure may be reversed, the enamel and a small portion of the dentine

removed, as in Fig. 26. If these methods do not seem to give sufficient anchorage, or the tooth is broken well up on the lingual, the cavity should be extended sufficiently on the lingual to gain the required retention, Fig. 27.

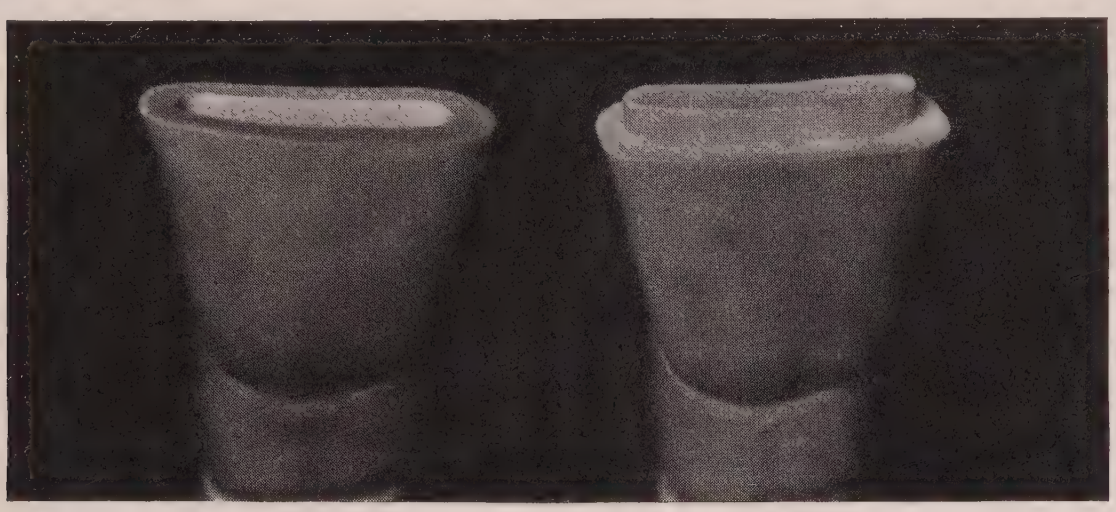


Fig. 25 Fig. 26

With the exception of very large, thick restorations, pins are contra-indicated as they so weaken the porcelain that it is sure to fracture at this point.

In atrophied teeth the labial margins should be extended gingivally sufficiently to reach the normal contour of the tooth, otherwise the inlay will be noticeable. If this extension does not go beyond the incisal third the retention may be formed the same as in fractures. If the defect is in the middle third of the tooth, it is advisable to remove the entire labial surface on account of the objectionable changes of the gingival third. First remove the enamel with carborundum stones, then shape with inverted cone burs, extending it to the free margin of the gums and well to the

Fig. 27 Fig. 28 Fig. 29

mesial and distal, Fig. 28 (mesial) Fig. 29 (distal). The porcelain should form the contact point with the approximating teeth, otherwise there would be danger of recurrence of decay.

THE MATRIX

Both platinum and gold foils have their advantage as a matrix material. While gold can be used only for low fusing porcelains, it has the advantage of close adaptation to the margins of the cavity, thus making a better fitting inlay with less burnishing. It has the disadvantage of becoming very soft when subjected to the heat of

the furnace, thus necessitating the careful investing of the matrix before baking. For this reason platinum is becoming more popular daily. There are three thicknesses of platinum foil upon the market ordinarily, 1-1000, 1-1200 and 1-2000. The thicker foils are more commonly used, the 1-1200 being preferable to the 1-1000. This foil is slightly thinner and is sufficiently rigid to withstand the manipulating of the porcelain without changing the shape.

It is not necessary to anneal platinum foil before using. As a rule it is much softer as it comes from the manufacturer than we can possibly make it without subjecting it to high temperatures in the furnace.

GINGIVAL CAVITIES

If we have prepared our cavity after the lines previously suggested it will be found to be very difficult to force the matrix to the bottom of the cavity without tearing. To facilitate matters it is an excellent plan to first shape an orange wood stick to loosely fit the cavity, as shown in Fig. 30. Over this the platinum is

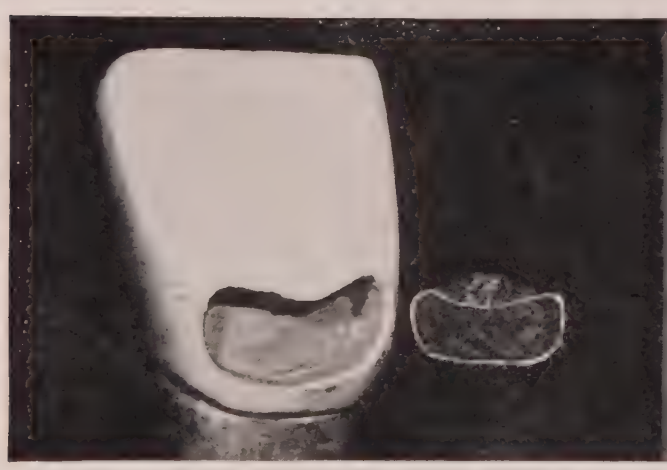


Fig. 30

Fig. 31

roughly formed, Fig. 31, care being taken to avoid large folds in the foil. If the stick has not been too large the foil will drop to the bottom of the cavity without a bit of pressure having been brought to bear upon the thin foil. Next, place a pellet of moist cotton in the bottom of the matrix thus formed and with one burnisher hold the matrix to place against the floor of the cavity while with the other carefully burnish, starting at the center of the floor and gradually working towards the walls of the cavity. At no time allow the burnisher to touch the platinum, always have an intervening cushion of damp cotton. The matrix should be adapted to every portion of the floor of the cavity before any attempt is made towards the walls or margins. The final burnishing is done along the margins and on the surface of the tooth.

At first thought you would think the folds, formed in shaping the matrix over the stick, would remain in the finished matrix; however, if it is carefully done every one will disappear as the burnishing proceeds.

After the burnishing is completed the matrix should be packed full of camphor gum (Dr. Allen) letting it extend slightly beyond the margins. This will tend to remove any rocking that may be present. After teasing the matrix from the cavity, the camphor may be burned away, leaving the matrix clean and in normal shape.

SIMPLE APPROXIMAL CAVITIES

The orange wood stick is equally of value in these, as it was in the gingival cavities. In the first case the end of the stick was fitted to the cavity, while in this the side is used, as in Fig. 32. The platinum is shaped over one side, the two edges and the end of the stick, as in Fig. 33. On account of the approximating tooth it

Fig. 32 Fig. 33 Fig. 34

is necessary to bend the edges of the platinum forming a flange around the matrix. In this manner the matrix readily goes to place even though there is but little separation, Fig. 34. The matrix is then filled with damp cotton and burnished to place, starting at the deepest part of the cavity and gradually working towards the margins. After this is accomplished any rocking of the matrix may be removed by stretching damp English twill tape tightly over the matrix, or better still, use a heavy rubber

Fig. 35 Fig. 36 Fig. 37

band, stretching this over the entire matrix and burnishing over this sufficiently to bring the platinum finally against the tooth.

If it is necessary to trim the matrix that it may be removed easily, it should be done before the final burnishing, then replaced and burnished, using the rubber band.

CAVITIES INVOLVING THE INCISAL EDGE

Ordinarily the most difficult matrix to form without tearing, is one for step cavities. But by carefully carrying out the following instructions it will be found very simple and in the step where folds are so annoying there will not be a wrinkle.

In shaping the orange wood stick, one side, the end and one edge are used, as in Fig. 35. Over this the platinum is shaped, as in Fig. 36, again bending the edge of the platinum back in the form of a flange in order that it may pass freely between the teeth.

Place in the cavity and pack with cotton and burnish carefully into the deep portion of the cavity, being careful not to permit the platinum folding over on the labial surface. It should stand perfectly parallel with the labial margin. With a pair of cotton pliers gradually bend the matrix into the step, Fig. 37. With a flat burnisher adapt closely to the labial wall and in the step, then with the same burnisher

Fig. 38 Fig. 39 Fig. 40

carry the surplus on the labial wall to place, Fig. 38. Next carry the approximal portion of the step to place, Fig. 39, and finally fold back the portion covering the gingival of the step, Fig. 40. This fold in the platinum stops at the cavo-surface angle, consequently it does not interfere with the adaptation of the inlay. Burnish over the lingual margin carefully and use the rubber band as in the preceding case.

EQUIPMENT

Before taking up the manipulation of the porcelain, I wish to say a word in regard to the necessary equipment.

It will be noticed that very few burnishers were mentioned in the making of the matrix. There are several sets, of from ten to fifteen instruments each, upon the market. These are good, but an unnecessary expense to the man who does not expect to make a specialty of porcelain, and even if he has this in mind, he has discarded all but one or two before he reaches the point to be called a Specialist. The writer seldom uses anything but the S. S. W. amalgam burnishers Nos. 33 and 34. In these we have two sizes of ball burnishers, two flat burnishers, the edge of which also works very nicely to draw the matrix into the angles of the cavity, and the angle between the ball of the burnisher and the shank makes a very good substitute for the notched burnisher commonly used to burnish over the cavo-surface

angle of the cavity. Thus the two instruments are really equivalent to six. Besides the two burnishers, the only instruments used were a pair of locking pliers and a pair of small shears for trimming the matrix.

In buying a supply of porcelain it is well to procure the whole set of colors, even though some of them are seldom used.

The selection of a furnace depends entirely upon the operator's surroundings. If he is located where there is nothing but a night current of electricity, or no current at all, he will have to get along with a gasoline furnace. While, if there is a day current, he should not stop short of an electric furnace with a pyrometer attachment. The time is coming when a man will be just as much out of place with a furnace without a pyrometer as he would be with a vulcanizer without a thermometer.

The proper baking of porcelain should not be underestimated. Many a good inlay has been ruined because the dentist thought he could time his furnace or tell by the glow of the muffle.

If you have no day current you can get very satisfactory results with the use of a device designed by the writer after the suggestion of Dr. Woodbury, of Council Bluffs, Iowa. Obtain a soapstone crayon from a book store or a dealer in metal

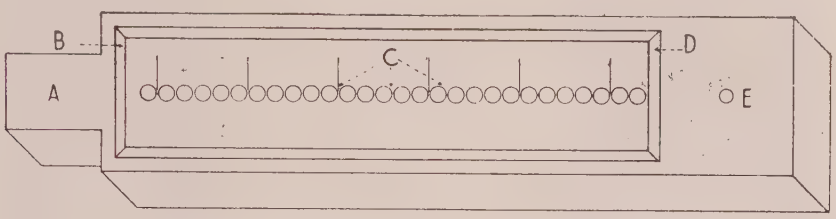


Fig. 41

worker's supplies. Take a piece two and one-half inches long and shape as in Fig. 41. At "A" it is simply made smaller to make a more convenient place to get a hold with tongs in putting in and removing from the furnace. From "B" to "D" it is hollowed out about 1-16 of an inch to prevent the gold dropping into the furnace. "C" is a series of small depressions made with a large size cherry bur. These should be as close together as possible without running into each other. "E" is a hole extending almost through the block and is used for holding crowns while baking, and also acts as a "center" for placing the inlay. As all gasoline muffles are hotter in the rear than in the front there is a certain point, between "E" and "D," at which the pure gold will melt, exactly the same time that a higher fusing porcelain reaches a proper bake, when placed directly over "E," which is in a hotter portion of the muffle. Pure gold should always be used and by a little experimenting one can regulate his pyrometer by shifting the pellet of gold from one hole to another so that he may get any kind of a bake he desires, from a biscuit to a high glaze. The inlay should be placed at exactly the same spot each time and the slab placed in the muffle exactly the same distance each time. A mica door should be used and the slab and work should be removed just as soon as the gold is seen to melt. The same device will work in electric furnaces, but not so well, as the heat is more uniform throughout the muffle.

SELECTING THE COLORS.

Many methods have been used in building up the colors for an inlay. A popular method is to select at least three colors, one for the gingival third, one for the middle third, and another for the incisal third.

Although we are dealing with a substance entirely different from the tooth structure, I believe the best results can be obtained only by following Nature's scheme. In this manner there is a gradual shading from the brownish yellow neck to the blue tip.

We will first consider the anatomy of a tooth. From a practical standpoint all dentine (unless artificially stained) is the same color, namely, a brownish yellow, and all enamel is blue. If this one point is remembered by the beginner, three-fourths of his trouble will be eliminated. It is so common to find a man trying to use every color in the outfit, when in reality two or three colors properly applied will meet almost every requiremant, except in discolored teeth.

A longitudinal section of a tooth will clearly show the relation of the enamel and dentine, Figs. 42-43. It will be noticed that the enamel at the neck is thin and the dentine predominates decidedly, while at the tip the enamel predominates. As the dentine is of a brownish yellow color and there is very little blue enamel covering it in the gingival third, naturally the tooth would have the color of the dentine, while

Fig. 42

Fig. 43

at the tip, where there is practically no dentine, it would take the color of the enamel, and in the middle third, where the dentine and enamel are more nearly equal, we find a composite of the two colors, or a greenish gray.

To prove that it is a difference in quantity of dentine and enamel, and the relative proportions of each that gives us the various shades in teeth, rather than a difference in coloring matter, examine a few of the patients who present themselves. Patient A——, we will say, has a decidedly yellow tooth. On examination we will find the crowns are short and labio-lingually they are very thick. The dentine extending to the cutting edge, Fig. 42. Patient B—— has a light blue tooth; here we find a much thinner tooth labio-lingually, Fig. 43, the labial and lingual plates of enamel come almost together in the middle third, consequently the tooth is light and receives most of its color from the enamel.

In selecting the color of a tooth, get the shade of the dentine as near the gingival as possible where the enamel is the thinnest, and select the enamel at the very tip, where it is free from dentine. Always cover the shade guide with a finger, except

an amount in proportion to the tooth. As a matter of convenience, the series of shades should be grouped together, ranging from light to dark. This makes the selection much easier. The normal dentine colors, in the leading makes of porcelain, ranging from light to dark, are as follows:

White's High Fusing: T, R, P, I, H, J, K.
Brewster's High Fusing: A, B, C, D, E, F, G, H.
Consolidated High Fusing: B, C, D, I, J, K, L, M.
Whiteley's Inlay Porcelain: 3, 4, 5, 6, 7, 8, 23, 24.
Brewster's Gold Matrix: 1, 2, 3.
Jenkin's Porcelain Enamels: 22, 20, 17, 4, 7, 27, 12
Brewster's Low Fusing: 1, 2, 3, 4.
The colors of the enamels are:
White's High Fusing: E, C.
Brewster's High Fusing: T; occasionally U.
Consolidated High Fusing: S, T.
Whiteley's Inlay: 13.
Brewster's Gold Matrix: 10.
Jenkin's Porcelain Enamels: 5, 25.
Brewster's Low Fusing: 11.

There is no rule in the selection of colors for discolored teeth. The discoloration is always in the dentine and may be a decided brown, or a dark blue, or a combination of the two.

In selecting the color for the dentine we may find the color between two shades upon the ring; if this is the case always select the darker shade—for example, if we were using S. S. W. high fusing porcelain and find "I" a little light and "H" a little dark, use "H." It is seldom necessary to use more than one shade for reproducing enamel.

APPLYING COLORS

In the high fusing porcelains it is advisable to first use a porcelain of different density, as the translucency of these porcelains is so great that if we should use the same porcelain throughout, we would have considerable trouble from shadows and cement, changing the color of an inlay. This porcelain, commonly known as foundation body, should be slightly higher fusing and of different refracting properties. It is not necessary, as some think, that this should be of a different color. On the other hand, better results can be obtained easier by using a foundation body of a color more nearly resembling the dentine.

We will first consider the building of the colors for a gingival cavity. After removing the matrix from the cavity, grasp it in a pair of pliers at some point where there is an excess of platinum.

Take a small portion of the yellow foundation porcelain upon a glass slab and mix with just enough water to make a doughy mass. There should be no excess of moisture standing upon the surface. A good way of knowing when the mix is just right is to pass the edge of the spatula through the mass; if the halves do not flow back together or break in cutting, the proportions of water and porcelain are correct. Take a small amount of the porcelain upon the point of the spatula and place in the bottom of the matrix, then with the gnarled portion of the handle, jar to place. An excess of moisture, or too much jarring, will have a tendency to separate the particles of porcelain, the heavier going to the bottom, leaving lighter on the surface, thus

ruining the quality of the finished porcelain. Just as soon as an excess of moisture appears upon the surface it should be removed either by bits of blotting paper or by touching the damp porcelain to the dry powder, then removing any that may stick with a dry camel's hair brush. This foundation porcelain should in no case come to the margins of the cavity, but should be built only to within about a millimeter of the surface, as shown in Fig. 44. It is not necessary to use any scheme to direct the shrinkage, such as cutting crosses in the porcelain, varnishing the matrix, etc., as even if the matrix does change, we have an opportunity of reburnishing, as we left all our margins free. This should be baked to a low glaze.

Fig. 44 Fig. 45 Fig. 46

After reburnishing, grasp the matrix in locking pliers and take a small quantity of the porcelain selected to restore the dentine and carefully fill the crevices caused by the shrinkage of the foundation body. Then add enough of the dentine porcelain to reproduce the dentine of the tooth. Great care should be taken in placing this porcelain, as just the right amount of space should be left for the overlying enamels. The dentine porcelain should be carried to the surface at the gingival, receding gradually as the incisal is approached, Fig. 45. If the shrinkage is excessive a second bake may be necessary. This should also be baked to a low glaze, and, in fact, every bake until the last, otherwise the porcelain would be overbaked on the finish. Next, restore the enamel with the blue porcelain, Fig. 46, never building it beyond the margins, as the amount of shrinkage is very uncertain. If the shrinkage brings the surface below the proper contour, add sufficient to restore the shrinkage.

Do not try to make inlays in a hurry. If a few extra bakes will give a better result, do not try to do it all in one.

The same scheme of building colors, as illustrated for gingival cavities, is used for simple approximal cavities.

In Fig. 46 you will notice the manner of building up the foundation porcelain. As before, the margins are kept entirely free, thus preventing a change in the matrix in this region and enabling the operator to reburnish if he feels in doubt of his adaptation. Fig. 47 shows the restoration of the dentine. If the cavity is large and the gingival margin extends to the neck of the tooth, this porcelain is built quite to the surface, receding as it approaches the incisal margin. It will be noticed that both the labial and the lingual surfaces are trimmed away about equally. This was done simply for the pleasing effect if examined on the lingual. However, the writer often thinks it prevents, to a large extent, the change in the inlay, from shadows. It may be necessary to apply this dentine portion the second time to compensate for the shrinkage. On this the enamel porcelain is built, bringing it *just flush* with the margins. This will necessitate a second baking, but it is difficult to judge shrinkage and it also gives one an opportunity of making a slight change in the colors if his first selection was not correct.

Fig. 46

Fig. 47

In cavities of the third class, the foundation body is carried only to within about a millimeter and one-half of the incisal edge, Fig. 48. The dentine porcelain may stop about the same point or extend entirely to the cutting edge, depending entirely upon the labio-lingual diameter of the tooth. As a rule we will find it necessary to extend the dentine quite to the surface at the gingival, Fig. 49, as we select the dentine where it is modified to a certain extent by the enamel and do not get the true dentine color.

In all cases be particular to restore the contour of the dentine as it originally was in the tooth, Fig. 50. The enamel is contoured exactly as you wish the finished inlay and just flush with the margins. Never guess at an excess which will compensate for the shrinkage, as there is no fixed rule regarding the amount of shrinkage and the less we use a stone in finishing our inlay the better the result.

Before taking up the next step, it may be well to mention a few precautions, helps, etc., in the working of the porcelain. Never lay the matrix down, but grasp it in a pair of pliers and lay the pliers so that the inlay will stand out from the edge of the table.

Distilled water is preferable to alcohol for mixing all porcelains, as it evaporates more slowly allowing ample time for carving the porcelain. Do not try to work the

porcelain too damp, as it is impossible to build contours, and the porcelain ingredients have a tendency to separate, thus producing a weak product.

It is seldom necessary to mix colors. Get shades by laying one color over another. Never attempt to build in the enamel color without having first baked the dentine color to a low glaze, as the colors will blend and produce an entirely different result. In removing an excess of moisture, the best absorbent is the dry porcelain powder which is being used at the time. Touch the inlay to the dry powder, then brush away the adhering particles with a soft dry camel's hair brush. Never use a damp brush to remove the excess of porcelain on the margins of the matrix, it simply makes a thinner layer of the porcelain and makes it difficult to remove. A better way is to loosen the particles of the body with the point of the carving in-

Fig. 48

Fig. 49

Fig. 50

strument and brush away with a dry brush. Remember that low fusing porcelains are more nearly opaque than the high fusing, consequently it is necessary to carry the dentine color to the surface of the inlay. Otherwise the enamel color will cut it out completely.

Before baking, always examine the under or cavity surface of the matrix to make sure there has no porcelain run over on that side. If there has, it should be removed before placing in the furnace, as it will be impossible to remove the matrix and will prevent the inlay going to place. Be sure the porcelain is entirely dry before placing in the hot furnace. Do not bake too rapidly. A much higher grade of porcelain will be produced by starting with a cool furnace and gradually raising the temperature, using plenty of time to allow the heat to penetrate the body. Placing in a hot furnace or raising the temperature too rapidly will cause a crust to form on the surface and the inner part will be porous.

Do not apply the body in the center of the inlay and expect it to flow to the margins by jarring. It may seem to do this, but at the final bake a row of bubbles will appear along the margins as a result of this. It is better to build all over the surface to a slight excess, then trim down to the desired contour.

REMOVING THE MATRIX

After the inlay has been properly baked, the next step is to remove the matrix. This should be carefully done by grasping the free edge of the platinum in a pair of pliers and peeling toward the center. This may be more easily accomplished by first dipping the inlay in water.

After removing the matrix the cavity surface of the inlay must be roughened to permit the cement to properly adhere. This may best be accomplished by imbedding the inlay in wax, leaving only the cavity surface exposed and etch with hydrofluoric acid. It should be left in the acid from two to five minutes, depending upon the porcelain and the strength of the acid. This is very important and should not be neglected. A simple gingival inlay with four antagonizing walls will not hold if it is not properly roughened.

The acid should be thoroughly removed by washing, using a fine, stiff brush.

Figs. 51-52

SETTING THE INLAY

The so-called "Cement Problem" has confronted the porcelain worker for years. A great deal of the change in color, on cementing an inlay to place, is due to a too thick layer of cement between the inlay and the cavity. This may be due to lack of adaptation of the inlay, using cement so thick that the inlay fails to go to place, or having a cement that is so coarsely ground that it will not permit the inlay going to place. The color of the cement has little to do with it, a light cement being nearly as bad as a dark under similar circumstances. Thin layers of cement will transmit light; therefore, if we expect our inlays to retain their color after setting, we must have our adaptation so perfect that the layer of cement will be thin enough to transmit light.

No cement should be used except one which is especially ground for inlay purposes. The writer prefers a cement pearl gray in color. This should be carefully mixed to a creamy consistency, being careful that there is sufficient powder to take up all the free acid. This should be spread over the dry cavity with an explorer, using as nearly as possible the exact amount necessary. Force the inlay to place and keep under pressure until the cement sets. If the work has been properly done there should be little or no grinding to do after the inlay sets.

GOLD INLAYS

Probably nothing ever introduced into dentistry was so universally taken up and created such wild enthusiasm as did the gold inlay, when Dr. Taggart introduced the casting process. There was scarcely a practitioner, no matter from how remote a corner of the land he came, who had not adopted the process within the year. And today, alas, how expensive this wild rush has been to many a man's practice. Undoubtedly greater care is needed in making a gold inlay than ever was called for in porcelain restorations. The difficulty in thoroughly roughening the gold to insure perfect adhesion of the cement, necessitates a careful consideration of mechanical retention in the cavity.

Although the casting process has decided advantages in most cases, there are certain cases when the old method of burnishing a matrix is preferable. While in others a combination of the two will produce the best results.

In small cavities with four walls, much time can be saved and an equally good inlay made by burnishing a matrix of platinum and filling with pure gold. In cases of large size where it is difficult to remove the wax without impairing the margins, a combination of a pure gold matrix and the remainder cast, is indicated.

Figs. 53-54-55

STUDY THE OCCLUSION

Before starting the preparation of a cavity for a gold inlay a careful consideration of the occlusion must be made. A cavity must have a resistance form to antagonize all stress upon the inlay or it will surely be dislodged. Have the patient move the jaws laterally and notice the stress in this direction, then mesio-distally, as well as at rest. Many peculiar conditions are brought out by doing this, which may completely change the nature of the cavity preparation.

CAVITY PREPARATION

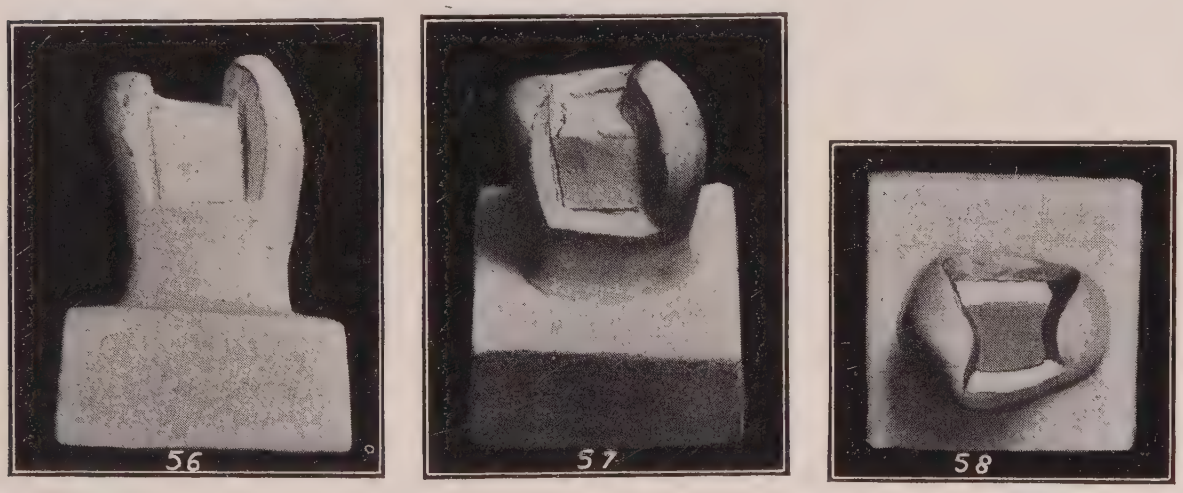
Simple Approximal Cavities

The general outline of a cavity for a gold inlay for simple cavities is very similar to that given for porcelain. In cases where the occlusion is normal, the lingual wall should be cut away to permit the removal of the wax pattern or matrix, in that direction. The incisal and gingival walls should be parallel to each other mesio-distally and there should be a decided seat under the labial wall. The incisal and gingival walls should diverge slightly from labial to lingual, to permit the removal of the pattern.

The technic of the operation consists of, first, breaking down any thin enamel margins and cutting away the lingual wall with chisels, always remembering that unless enamel has an underlying support of dentine, it is worthless and should be removed. Next, with a smooth square-end fissure bur in a right angle, entering from the lingual, extend the gingival margin sufficiently to permit the removal of the pattern. Form the incisal wall in the same manner, and with the square end of the bur cut the seat under the labial wall. Then, with hatchet and hoe excavators make a definite angle at the junction of the incisal, gingival and labial walls with the axial. In very deep cavities it is well to build in with cement, care being taken not to carry it to an extreme. All margins should be smooth and slightly beveled.

CAVITIES INVOLVING THE INCISAL ANGLE

In this class of cavities it is preferable to use a step for incisal retention. In cutting this, fine grit carborundum stones are used, extending it sufficiently laterally to permit making a pit in perfectly sound dentine. On the labial, only sufficient should be cut away to give the enamel a protection of gold. Much less cutting is necessary as compared with that for a gold filling.



Figs. 56-57-58

The lingual wall of the step should be cut away to permit good anchorage in dentine. At the end of the step should be a well defined pit.

The body of the cavity is prepared much the same as that for porcelain, cutting away the lingual to permit the easy removal of the pattern. The gingival wall should be flat and there should be a flat seat under the labial plate. In deep cavities the axial wall may be built out with cement, care being taken that all margins are freed from cement before the impression is taken.

CAVITIES IN BICUSPIDS AND MOLARS

The ideal place for gold inlays is in the bicuspids and molars. They eliminate the great difficulty of placing cohesive gold in inaccessible cavities and have greater strength. Within a very short time the inlay will almost take the place of the gold crown. The misfitting band and inflamed gum will be a thing of the past.

In all proximal cavities in bicuspids and molars there should be a step including all fissures on the occlusal surface.

Figs. 56, 57 and 58 represent a cavity in the bicuspid. In the proximal portion there should be a flat gingival seat, the buccal and lingual walls should be as near parallel to each other as possible and permit the removal of the impression. The

occlusal portion should be of sufficient width and depth to give strength to the inlay and should terminate in a definite dove-tail which affords retention from dislodgment approximally. In badly decayed teeth, the cavity should be built out with cement, to within a millimeter and a half of the surface. This will give sufficient bulk of gold and will make the inlay of better retention form.

In larger cases, especially where both mesial and distal surfaces are involved, and the buccal and lingual walls are weak, the cusps should be removed and the tip restored with gold.

Molar cavities, Fig. 59, are prepared along the same lines, making an occlusal step extending into all the deeper fissures. The pulpal and gingival walls should be flat and at right angles to stress. The buccal and lingual walls should be as near parallel to each other as possible and permit the removal of the pattern.

All the above cavities are for the restoration of lost tooth structure, and are not intended to carry lost teeth in bridge work. The cavities following are intended more especially for use in bridge work and the retention of teeth.

Fig. 59

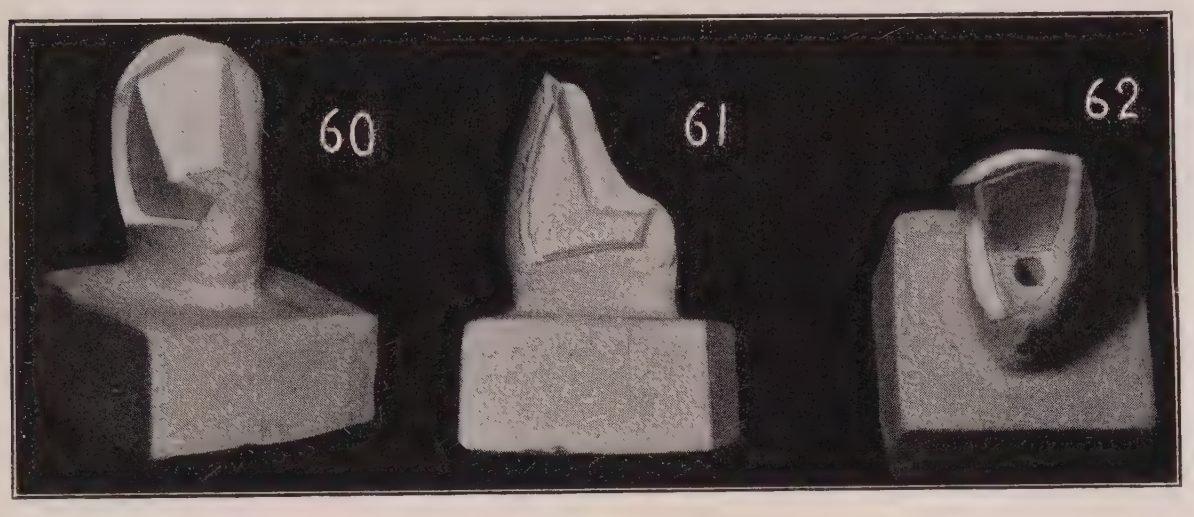
GOLD INLAYS FOR BRIDGE ABUTMENTS

The casting process opens a field in bridge work of inestimable value. In the past many teeth have been mutilated for the construction of bridge work, which in the future will be saved almost in their entirety with the use of inlays. We have all experienced the difficulty of properly shaping molars and bicuspids to permit a close fitting shell crown. While in the anterior teeth it necessitated the use of a shell crown or the entire destruction of the crown of the tooth for a Richmond crown to permit of bridge work. With inlays a much more sanitary and an equally strong anchorage may be made. It is a system, however, that will necessitate the greatest care on the part of the operator in regard to every detail in the preparation of the cavity adaption of the inlay and attachment of the dummies.

In preparing a cavity for an abutment we should *examine* the *occlusion* minutely and make a careful estimate of the stress that will be brought to bear upon the restoration. Always bear in mind that there is a certain amount of movement of teeth in their sockets and that the movement may not be equal at both ends of the bridge; hence unless we have an absolute mechanical anchorage the inlay will surely be dislodged.

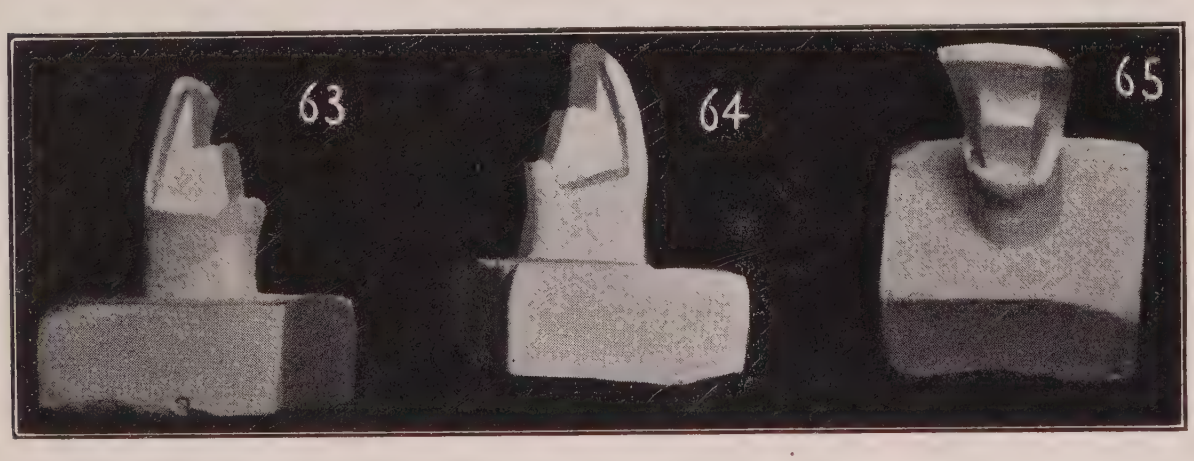
We will first consider the preparation of a cavity in a cuspid. In most cases it is advisable to devitalize and use an iridio-platinum pin as anchorage. After having

removed the pulp and filled the canals, take a carborundum stone and remove the approximo-lingual angle. Then with inverted cone burs extend the proximal portion well to the gingival, Figs. 60-61-62, making a flat gingival seat. The approximal portion of the cavity should be extended labially sufficiently to make the labial margin perfectly self-cleansing and at the same time not so far as to show the gold appreciably. The pulpal wall of the main portion of the cavity should be



Figs. 60-61-62

made flat and at right angles to the long axis of the tooth. The incisal edge should be cut away sufficiently to permit its restoration with gold. In no case should the labial plate be left standing without this protection. All margins should be at right angles to the surface of the tooth with a slight bevel of the outer third of the enamel. The root canal should be enlarged to admit a 16-gauge iridio-platinum bar and be a depth equal at least the length of the crown of the tooth.

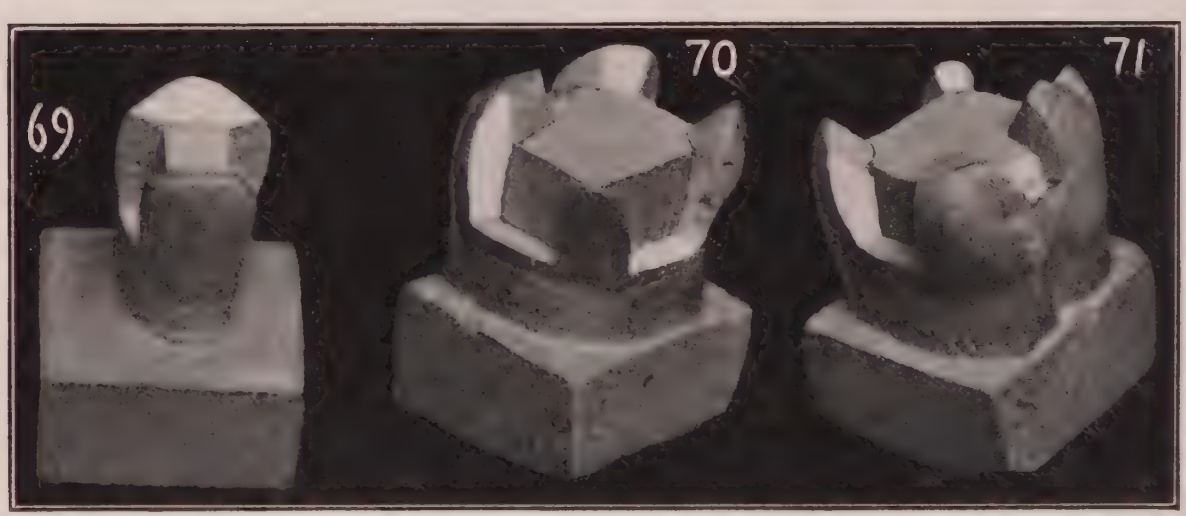


Figs. 63-64-65

In cases for small bridges a staple inlay may be used without the necessity of devitalizing, as Figs. 63, 64, 65. The lingual plate of enamel is removed with carborundum stones entirely to the incisal. Each approximal surface is prepared similar to that described above. Then with inverted cone burs make the lingual wall flat and at right angles to the surface. At the junction of the middle and incisal thirds a step is formed with an inverted cone bur. The cavity should be extended to, and include, the incisal edge, which should be restored with gold.

Figs. 66-67-68

Figs. 66, 67 and 68 represent a lateral incisor with an approximal preparation for bridge anchorage. In this case the cavity is stepped on the incisal and an 18-gauge iridio-platinum pin extends into the canal from the step. In all cases the important points are, first, extend the cavity to self-cleansing areas; second, obtain a thorough resistance form, and third, procure positive anchorage from all stress.



Figs. 69-70-71

In bicuspids and molars there should be post anchorage in badly broken down cases. Where the greater part of the tooth is intact, the cavities should include both mesial and distal surfaces extending well to the gingival on both approximal surfaces. Fig. 69.

Figs. 70 and 71 show a badly broken down molar with the pulp chamber built out with cement. In these cases it is important to have flat gingival seats with sufficient breadth to withstand stress. All the cusps should be ground away sufficiently to protect them with gold.

FORMING THE MATRIX OR PATTERN

In small approximal, pit, gingival and occlusal cavities, it is much easier and quicker many times to use the old method of forming a platinum matrix and filling with pure gold, rather than the new method of casting.

We will take for example a gingival cavity. Here we have the secretions of the mouth to annoy us, as well as the close proximity of the gum margin. The wax has a tendency to crumble under moisture and again it is difficult to remove the wax when the cavity extends beneath the gum. In simple approximal and small occlusal cavities it is a comparatively simple matter to burnish a matrix, within a very few minutes it may be filled with gold and ready for cementing to place and finish.

The method preferred would be to form an orange wood stick to loosely fit the cavity, over this shape a piece of 1-1000 platinum foil as described for a porcelain inlay, (Figs. 30-31). Remove the matrix and place in the cavity and burnish to place, being careful to spread over the floor of the cavity first, then gradually over the walls and margins. The excess may be trimmed almost entirely away along the gingival margins if the gum interferes. Remove from the cavity, heat in a flame until all carbon has been burned off, cool and coat the surface next to the cavity with a thin solution of chalk in alcohol. Great care should be used in applying the chalk, not to permit any to run into the matrix, as it will cause no end of trouble in melting the pure gold. Allow the alcohol to evaporate, then place the matrix upon a soldering block and fill about one-half with pure gold. Do not use flux, as it is unnecessary and causes pits in the inlay. Immediately drop the matrix into nitric acid which will remove the chalk. Place in the cavity and reburnish. Unless the inlay is large the second time the gold may extend to the surface. After cleaning in nitric acid, roughen the surface with a small bur and cement to place. Before the cement starts to crystalize, burnish all margins carefully. Then finish the same as a filling. If there are small tears in the bottom of the matrix there will be no danger of the gold flowing through, if the cavity surface is carefully coated with the chalk.

In large contour cases the preferable method is to use the casting process. When this method was introduced, it seemed so easy and simple that the majority of men rushed at it with little thought of what the probable outcome would be. There is no operation in dentistry more difficult than properly removing and investing a wax pattern. This may seem a strange statement but it is true, nevertheless. In the first place the cavity should be so prepared with parallel walls that there is a certain amount of frictional retention and if this is done there is considerable danger of distorting the pattern in removing.

When it comes to investing the pattern there is great danger of changing its shape.

THE WAX PATTERN

In considering this step in inlay construction, it is important that we first consider the material we are to work with. There has been almost as many makes of wax thrust upon the profession as there have been casting machines, and the majority are absolutely worthless. The fact of the matter is, our best base plate waxes are far superior to the majority of inlay wax offered for sale.

The important feature in an inlay wax is to have one with the least possible amount of inorganic material present. In other words, one that can be completely destroyed by moderate heat. The next essentials are, tenacity, close grain and rigidity when cool. The ideal wax should be one that could be softened and formed in a cone with dry heat and when soft should work like chewing gum. When forced into the cavity it should not crack or crumble, but mold to any form desired, either with the use of the fingers or instruments. After chilling, it should carve easily and take on a high polish.

When making the wax pattern, the tooth should be slightly moist to prevent the wax sticking. Warm the wax until it is like putty, shape in the form of a cone and force into the cavity with the thumb and finger, compressing the wax as much as possible with the fingers to insure perfect adaptation to the walls of the cavity. In approximal cavities an excellent plan is to use a heavy piece of dam, placing it between the teeth, first allowing it to rest against the approximating tooth until the wax is forced into the cavity, then with considerable tension upon the rubber, force the wax to place in the cavity. With flat burnisher, working from the center of the cavity towards the margins, work down smooth and at the same time remove the excess. The wax should be as nearly as possible the exact contour desired in the finished inlay, having no more of an excess over the margins than the thickness of paper. After getting as smooth as possible with the burnisher, polish with a pellet of cotton or a soft tape passed between the teeth.

Great care should be used in the removal of the pattern. It is best not to attempt the insertion of the sprue until the pattern has been removed, as many times it would be impossible to attach at the most advantageous point. With gentle pressure upon the labial and lingual surface, using a small pellet of cotton in the cotton pliers, loosen the pattern. The greatest care should be used in its handling

Fig. 72

after it has been dislodged, as the margins are thin and easily bent out of place. A very convenient receptacle to allow the pattern to drop onto, from the cavity, is a large size mouth mirror frame, one that has the glass broken away and replaced with a thin layer of cotton. As soon as removed, the sprue should be attached and the pattern covered with a thin layer of investment and should never be permitted to lie around, even in water, for some future time to invest.

In bicuspids and molars after forcing the wax to place in the cavity, have the patient close his teeth and move the jaws laterally, in order that the occlusal surface may be as nearly perfect as possible. After trimming down the approximal portion and smoothing as much as possible, have the patient close again to make sure the wax has not been misplaced in the smoothing process.

A careful examination of normally occluding teeth will show the fissures and sulci of the tooth extend deeper than the tip of the occluding tooth. So we should carve the fissures slightly deeper than the impression made by the occluding tooth. A very good tool for this purpose is a small pointed lancet, or in many cases the ordinary hook scaler is excellent. After shaping the occlusal surface the occlusion should be again tested to make sure the wax was not misplaced in carving.

At this point it might be well to mention the use of iridio-platinum pins as anchorage. In many cases it is not only difficult to get the wax into the pits but it is uncertain about their casting and lack of strength when cast, so a much better method is the use of pins. An iridio-platinum wire, about 20 gauge, is preferable for incisal anchorage, and 16 gauge for anchoring single inlays in root canals. If the inlay is to be used for bridge retention, 14 gauge sprue wire should be used. In getting

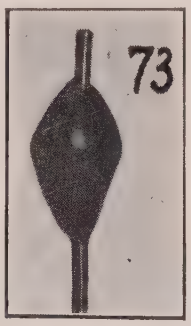


Fig. 73

the pattern for an inlay where 20 gauge wire is to be used for incisal retention, it is best to force the wax home in the cavity first, then heat the pin slightly and push it through the wax into the pit.

In using pins in the canals, it is better to shape the wax in a cone around the pin before inserting into the cavity, having first shaped and bent the pin to conform to the cavity and canal.

In an inlay to be used as an abutment for a bridge, a square 14 or 16 gauge iridio-platinum pin should be used. The pin should extend into the canal at least

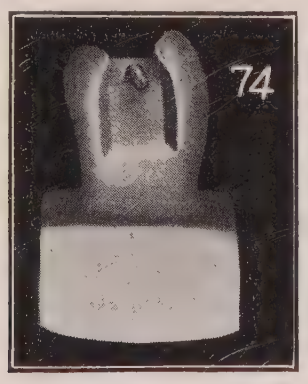


Fig. 74

the length of the crown of the tooth, and should be bent at right angles and extend beyond the contour of the tooth sufficiently to insure thorough union with the dummies of the bridge.

The writer does not believe a soldered union direct with an inlay is good practice. In the first place our solders lack strength and consequently in order to get sufficient strength it is necessary to use such a large quantity of solder that we have destroyed our self-cleansing margins. By using the heavy iridio-platinum union, all margins can be made self-cleansing without weakening the bridge. If we are using a vital

tooth as an abutment, it is a question in the writer's mind if it is good practice to attach the inlay direct to the bridge, unless the extension is very large. A simple approximo-occlusal cavity in a bicuspid should never be used in this way. If the cavity is a mesio-occluso-distal, it may prove satisfactory, but the inlay should always be constructed with the use of an iridio-platinum wire, as shown in Fig. 75.

If a simple approximo-occlusal inlay is used for anchorage it is not well to make a solid union to the bridge, but instead, the iridio-platinum bar should rest within a tube and set in the inlay. This is easily formed by shaping a piece of platinum plate over the wire to be used, and this set in the wax in the region of the contact point. This method allows a certain amount of movement which is always present during mastication, and prevents dislodgment of the inlay.

Fig. 75

In attaching the sprue, care should be taken to attach at such a point that the gold will be forced as near as possible towards all margins of the inlay. If this precaution is taken the defects, if any, will not be at the margins but some place upon the surface of the inlay where it can be more easily repaired.

INVESTMENTS AND INVESTING

This particular phase of inlay work does not receive the attention it should. In the first place the wax pattern should be so carefully made and polished over the surface that it is without a flaw, then secondly, it should be invested with an investing material that will conform to the pattern and produce a casting as perfect as the original pattern. Our neglect lies in using a too coarse investment and the careless manner of applying it.

It is preferable to use a fine investment first, one which is easily painted over the surface of the pattern and later invest in the cup with a coarser, more substantial material. An excellent preparation for first coating the pattern is equal parts powdered rouge and plaster, while there seems to be nothing better than equal parts of extra fine powdered silex and plaster for the outer investment. If these investments are prepared by the dentist, he should be careful about thoroughly mixing the ingredients, otherwise the investment will crack and shrink. It should be passed through a fine sieve at least five times.

After removing the wax pattern from the cavity and attaching the sprue wire, examine very carefully, and if there is any collection of saliva or blood, the pattern should be thoroughly cleaned, first, in a stream of water from a water syringe, then

wiped carefully with a brush or pledget of cotton, moistened in alcohol. Attach the sprue wire to crucible former and we are ready to invest.

Mix a small teaspoonful of the red investment with water until it is the consistency of thick cream, then with a small camel's hair brush paint the surface of the pattern carefully, making the first application very thin and be particular about working it into every minute angle. Gradually build up with this investment until there is a thickness of at least 1-8 inch over the entire pattern. This investment should extend down over the sprue wire and crucible former, otherwise there might be a slight crack between the fine and the coarse investments, which would fill with gold and possibly destroy the value of the inlay.

After the fine investment has set, nearly fill the cup, if you are using that style of receptacle, with the coarser investment and invest the pattern and sprue and with gentle jarring settle to place. If a ring is being used, set it over the inlay and fill with the investment, being careful to work into every minute crevice and irregularity of the first investment.

After the investment has set, the ring should be placed over a slow fire to dry. It is preferable to have the investment heat slowly, as there is less danger of a change. The heat should be gradually increased until the investment is a dull red to the center, when it is ready for casting.

PREPARATION OF GOLD

It is very important to have our gold for casting free from all foreign matter before placing it in the crucible to be cast. If we have been particular with the treatment of the wax pattern previous to this time and it is a perfect counterpart of our cavity, very little burnishing of the margins is necessary. Consequently it is possible to use our scrap plate rather than pure gold. If we have been reasonably careful with our scrap, kept it free from platinum or silver, the color is not bad for fillings and it has the advantage of retaining its shape better than pure gold.

If scrap is used, it should first be boiled in 50% nitric acid to remove any base metals that may be present, wash and place upon a charcoal block and melt. While the mass is in a molten condition it should be sprinkled with Ammonium Chloride (Sal Ammoniac). This should be repeated until the gold ripples like water. This may be remelted in a carbon crucible and cast into ingots for use or used as it is.

If we are melting our gold in a crucible formed in the investment very little flux, if any, should be used, as there is danger of its closing the opening into the mold, thus preventing a perfect cast, if the gold goes down at all.

The importance of having our gold in perfect condition for casting must not be overlooked.

It is hardly necessary to mention machines for casting, as there are so many and all will get results if properly handled. Some require a little more care than others, but good inlays may be had in any, from a tin can lined with wet asbestos to the most complicated machines. I think, however, the centrifugal principle among inexperienced college students, will give the most uniform results.

After the inlay is cast it should be washed thoroughly to remove all investment attached, then placed in Hydrofluoric Acid, which will remove any fused silex. The sprue should then be carefully cut off and the cavity surface examined minutely for any small bubbles of gold that may be attached. If the red investment was painted on very thin at first there will be little trouble in this respect.

If there is any difficulty in getting the inlay seated in the cavity, an excellent method is to heat the inlay slightly and apply a very slight layer of mercury to the surface; this will unite with the gold and, upon evaporating away with increased heat, the gold will be left with a frosted surface. If the inlay is now placed in the cavity any point that may rub against the walls will become burnished and can be cut away. When the inlay goes to place perfectly, the surface should again be etched for the better adhesion of the cement.

All inaccessible surfaces of the inlay should be trimmed and polished before setting. However, if it is possible to reach the margin with a burnisher, it should be left slightly flush to permit a thorough burnishing before the cement sets, after which the margins should be finished and polished the same as for a gold filling.

AMALGAM BASE FOR GOLD INLAYS

By Steele F. Gilmore, D.D.S., Indianapolis, Ind.

In deep lying approximal cavities that are inaccessible (such as are distal cavities in molars and bicuspids) rendering the adaptation of the wax model and its gold replica to the cervical border uncertain, resulting in secondary or recurrent decay at this point, this method is indicated.

Technic: After the preliminary opening of the cavity in a gross way, apply the Ivory band matrix, and with it in place excavate the cavity floor with right angle burs. The matrix acting as a guide to your instruments prevents them from slipping into the soft parts, causing unnecessary pain and irreparable damage to the delicate tissues occupying the interdental space. If you are satisfied with the preparation of the cavity floor, together with its buccal and lingual walls, remove the matrix and carefully stone the margins. Now if the approximal surface of the neck of the tooth is irregular (concave, for instance) you can, with pliers, so swage and manipulate this soft steel as to adapt it accurately to the surface above mentioned. Properly mixed amalgam, in *very* small pellets, may now be vigorously burnished in and built up as far as your judgment may dictate. Insert temporary stopping until the next sitting, when complete preparation of the occlusal surface can be made. Or a quick setting amalgam may be used and the model obtained at the first sitting.

Advantage: A perfect adaptation, without any of the elements of guess work in this dark corner. The surface alignment of your filling is automatically provided for at the cervical margin. To the delight of the patient, approximal trimmers and burnishers are not needed. You have re-inforced the weak point of all inlays. There can be no electrical disturbance, since the two metals are insulated by the intervening cement.

SOME PLACES WHERE THE CASTING PROCESS HAS BEEN FOUND USEFUL

By E. T. Tinker, D.D.S., Minneapolis, Minn.

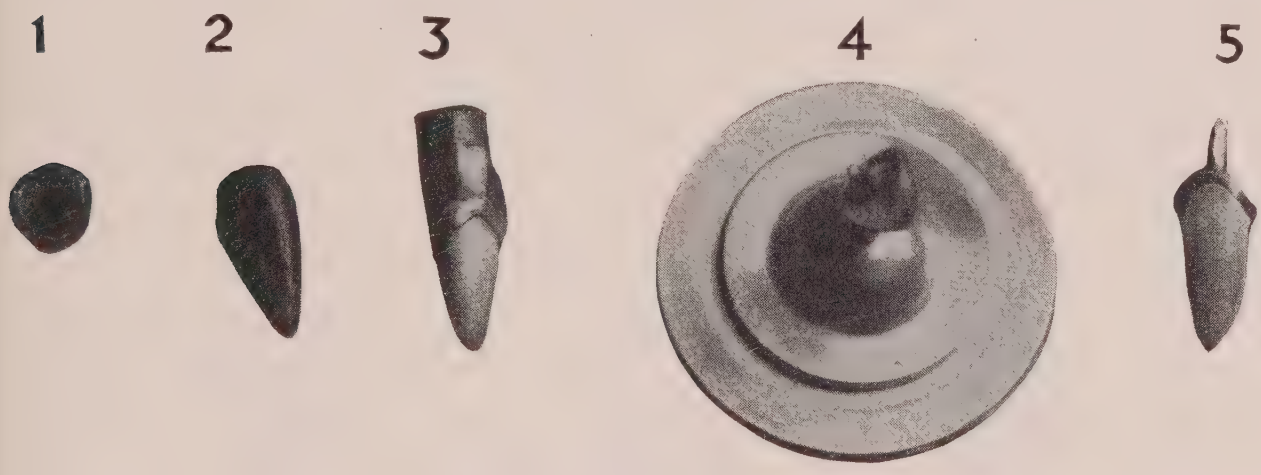
In the following article it will be my endeavor to give you a few applications of the casting process.

The first of which will be a method of casting a coping for a Richmond or Porcelain crown, where it is necessary to reproduce the entire enamel margin, as in cases of split roots, roots that have been supporting crowns and through improper preparation are causing gingivitis, as well as many other cases that may come under our care.

CASTING A COPING FOR RICHMOND OR PORCELAIN CROWN

In brief, the procedure is as follows:

Before removing all the enamel and beveling the root, take the measure and make band of 22k.-30g. gold plate, contouring and roughly fitting same (Fig. 1). Prepare the root as in Fig. 2; place the band in position and force softened casting wax to place (Fig. 3). The band being slightly larger than the root acts as a matrix, forcing



Figs. 1, 2, 3, 4 and 5

the wax in direct contact; the free margin of the gum determines the depth to which it shall go. Trim away all surplus wax, warm an iridio-platinum pin and force through wax into the canal, attach the sprue and remove band, wax and post intact, mounting same on crucible former (Fig. 4) and cast. By the aid of stones and disks, dress down and polish, leaving a finished coping (Fig. 5), which is very strong and one to which the gums take kindly.

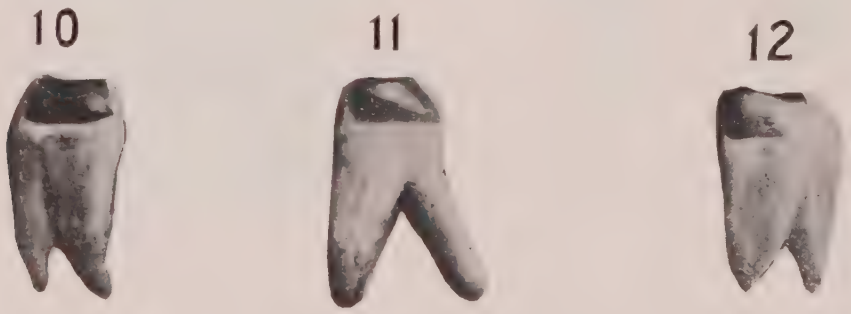
I was very much interested in reading Doctor Kabell's article in the May number of *Items of Interest*, from the fact that it brought out the same difficulty which some of my friends as well as myself have been having with the shrinkage of gold when cast.

TIN FOIL TO CONTROL SHRINKAGE IN CASTING

Through the courtesy of Doctor H. A. Knight, I will give you his method of using tin foil to control the shrinkage in casting boxes for porcelain bicuspids and molars when used as dummies for bridge work. Take a common pin tooth, molar or bicuspid, cut off the pins and grind it as shown in Figs. 6 and 7; Fig. 6 showing it from the occlusal and Fig. 7 from the gingival point of view. Take a sheet of casting wax and adapt some very thin tin foil over one side of it. Warm the wax and press to place, having the tin foil next to the ground surface of the tooth and carve as you wish the finished piece. Attach the sprue in some convenient place, chill and using

Figs. 6, 7, 8 and 9

sprue as a handle, remove wax and foil from the tooth, chill again and with a pair of small pliers grasp the foil by some small projection and separate from the wax (Fig. 8), being careful not to distort wax form, invest and cast. The space gained by the foil will just about compensate for the shrinkage of the gold, the tooth slipping to place without further grinding (Fig. 9).



Figs. 10. 11 and 12

GINGIVAL MARGIN RESTORATION

Another place where difficulty is often encountered is at the gingival margins in large M. O. D. inlays. Doctor F. B. Kremer, of this city, suggested that in cases where we have an otherwise perfect inlay, that we grind away a part of the defective margin (Fig. 10), placing a little inlay wax and forcing inlay home over it (Fig. 11). Remove inlay and wax intact, casting anew, which gives a very good result (Fig. 12). This idea has been carried out in a good many different ways, for instance where a

margin of a cavity containing an otherwise good inlay has become fractured, or where a root has become affected by caries under a well made Richmond, the defective parts of tooth can be prepared, wax placed over them and the old work pressed to place, removed intact and cast, producing practically a new piece of work. Numerous other conditions will present themselves to which this idea can be applied advantageously.

CAST GOLD CROWN

For contact, contour, occlusion and perfect relation to the root and gums, the gold crown made by the following method comes as near the ideal for posterior teeth as anything I have as yet found. Prepare the root along the accepted lines, construct a gold band of 22k.-30g. plate and accurately adjust to the root and gingival, paying no attention to contour as that will be taken care of later. Obtain a bite of occluding teeth in wax and an impression of band and teeth mesially and distally in plaster. Remove band and place it in impression. Make models and mount on an anatomical articulator, oil all plaster adjacent to band, place warm casting wax in band and close the articulator, giving it a lateral motion as in mastication, so as to produce a correct occlusion, and carve. With a camel's hair brush paint melted wax on exterior of band and carve contact points and contour. Remove from model, invest and cast and when finished it will be found as near anatomically correct as any which have so far been made, and its one great advantage lies in the fact that by not contouring the band, we do not take the risk of disturbing its relation to the root, the perfection of which we are all aware is the cardinal point in the construction of any crown, the health of the surrounding tissues and the life of the operation depending almost wholly upon it.

CAST GOLD SPLINTS FOR PYORRHEA

By Dr. J. G. Lane, Philadelphia, Pa.

Showing more particularly a method of uniting the two plates of the splint and the technique of making up the uniting medium.

Fig. 1. Finished splint in position. The two plates fastened together by means or iridio-platinum screws.

Fig. 2. Pattern for one plate of splint, showing graphite rods in position to core the hole for the screws. In order to get the proper lineup for the cores they are placed in wax pattern before the latter is removed from the model.

Fig. 3. Iridio-platinum blank for screw. Surplus material for head obtained by partly fusing the end of the wire.

Fig. 4. Heading tool. Made by drilling a hole in a piece of steel and counter-boring the hole to any sufficient depth with a round bur. This must be tempered.

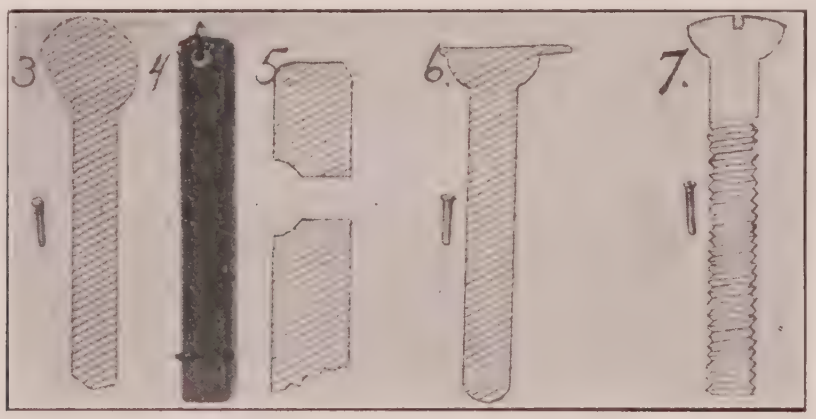


Fig. 5. Sketch showing section of Heading Tool. (Note shape and depth of counter-bore.)

Fig. 6. Screw blank after same has been placed in the Heading Tool and the surplus for head hammered down in counter-bore.

Fig. 7. Finished screw. Shank threaded, surplus material on head removed with a file and slot cut with ribbon saw.

CAMPBELL'S COW-BELL METHOD OF CASTING PLATES

By Dayton Dunbar Campbell, Kansas City, Mo.

In describing this simple and unique method of casting aluminum plates, we will not go into the question of the superiority of the cast metal denture over one made of vulcanite, but give in a homely way the procedure in detail:

INVESTMENT MATERIAL

After taking your impression, coat it with your favorite separating fluid and *when dry rub* well with *soapstone* and pour with an investment compound after the formula originated by Dr. C. C. Allen, which consists of *equal parts of Portland cement and dental plaster.* This compound is in keeping with the simplicity of the casting machine, and in fact, is cheaper than plaster, sets very fast and is free from shrinkage and expansion, making an ideal compound in bridge work.

It is hardly necessary to say that the plaster and cement must be mixed dry beforehand, and so thoroughly that when patted down with a spatula no particles of plaster are distinctly recognized. To obtain the best results, this material must be worked thicker than plaster.

SEPARATION

On separating the impression from the model, if the former when poured is jarred down well, the model will present a finished surface. The part of the *model* the plate is to cover is now *rubbed* well with *soapstone.* This gives the model a metallic luster and a surface very desirable to cast metal against.

WAX

The model is now covered with a new, clean piece of common yellow *base-plate wax* and care taken that it is of *even thickness* throughout, and that it has not buckled on the ridge in the median line. The wax is now *trimmed* as you wish the *plate to be,* and care taken to cut it low where the depressor muscles have action, usually in the region of the first bicuspid. The *outer edge* of the *wax* is now *stuck* to the *model* all the way around with a dry, sizzling-hot spatula, held at a right angle with the wax. A *strip of wax* 3-16 of an *inch wide* is now cut lengthwise from a sheet of wax and *laid* down *flat* on the *wax* model, even with the edge, except near the heel of the plate, where it is brought over to the lingual surface. The wax strip is brought as near the top or bottom of the ridge on the palatal or lingual surface as the case will permit, the idea being to do away with as much rubber as is possible. The outer sixteenth of this strip is now made a part of the wax model by thrusting a dry, hot spatula through the strips all the way around *until the model is felt* beneath. The surface next the outer border of the strip is now filled in with wax and smoothed up with a chip blower and alcohol lamp, care being exercised to leave the inner edge of the strip square. At this point lower the temperature of the wax, which has become soft by working, by dipping model and all in water that is not cold; then, with a dull instrument, *raise* the *inner border* of the *wax strip all the way round,* as is shown on right side of Model No. 1. It should be lifted away most near the canine eminence and the lingual border of the heel. If this is done right, it affords all the attachment necessary. Sometimes it would be impracticable to use the strips on the labial border;

it can be done away with altogether, and for the attachment of the rubber, loops of German *silver or aluminum can be set in place* on the *wax* and *cast successfully.* Of course, there is no union of the metals, but they are held in place mechanically tight enough to serve their purpose.

If you desire to cast directly on the teeth, the front is left open for the pink rubber, and a space of one-half to one millimeter left between all the teeth. This is imperative, because the contraction of the alloy or metal used in casting the teeth would all be checked or broken off.

The model is now trimmed even with the heel of the plate and a little roll of wax, about the size of a slate pencil and about three inches long, is stuck on the model with a hot spatula, even with and joined to the wax plate. Don't lay this piece of wax over on the wax, as it will not facilitate casting, but will be difficult to remove in the cast.

The last thing to do before you invest is to cut the model all over to get rid of the "slazy" surface it has taken on from handling, rubbing with soapstone, etc., so it will unite, so to speak, with the investment, and put it in a bowl of cold water. *The flask is a No. 5 Hoosier cowbell,* and will cost you seventy cents.

The strap at the top of the bell is placed in a heavy vise and removed. The rivet that holds the clapper is filed off some and driven out with a punch. A one-eighth inch hole is bored a half-inch from the mouth of the bell at its extreme width on either side, to afford attachment for three feet of bailing wire, and you now have a plate-casting machine, as shown in the cut.

INVESTING

To invest: Begin mixing your home-made investment compound, and while it is thin, remove the model from the water and with a camel's hair brush fill in the grooves made by lifting the wax strip; then, working quickly, mix the investment thick and pour it in the cow-bell (it should be not quite *two-thirds* full), now put in the model; then, by holding the cowbell between the thumb and three fingers of either hand, the index fingers are left free to push the model down; it should be jarred and pushed down until the model is about an inch below the surface, or, say until the fingers are in the investment to the first joint. Now remove the fingers, and by pressing on the wax pencil the model is kept in place while the jarring is continued until the surface of the investment is even.

The surface now presents a semi-liquid appearance which is immediately sprinkled with the dry investment to hasten the setting. In a very few minutes the top of the investment is scraped with a large vulcanite scraper (no attention is paid to the wax pencil, it being cut or twisted off and scraped down with the investment); until it is firm and solid. Then the investment, from an inch to an inch and one-half on all sides of the wax is lowered about one-half inch and the whole top washed out to get rid of any small particles that might fall into the investment and cause a hole in the plate.

The bell is now placed on a *slow fire* and the *wax* burned out.

This idea of the disappearing model, of course, belongs to Dr. Taggart, and it is to him all credit should be given should this article prove beneficial to you.

The *burning of the wax* usually takes *an hour or more.* When the bell can be removed from the fire and there is absolutely no smoke issuing from it, you are ready to cast. The flask does not have to be very hot, and for this reason a very good cast can be made over a common plaster-paris model. If you are going to cast

directly on the teeth, the method of investing and removing the wax is also a little different. The teeth are painted with whiting to prevent any excess of the metal adhering to the porcelain, a phenomenon that occurs that to me is very striking. An attempt to remove a film of the aluminum that may have run over one of the teeth without whiting means to remove just so much of the porcelain.

Place the flask on its side in a clean vessel and fill with *cold water* until it is covered *two* or *three* inches, *set on a slow fire* and bring to a boil until the *wax is all out.* Place on fire as before and heat slowly, but in this case, before you cast, the case must be heated pretty hot to bring the temperature of porcelain up to something near the temperature of the molten metal.

To cast, the cowbell is laid on one side with the mouth elevated an inch or so. An ingot of pure aluminum, or Aerdentalloy, is then laid in the mouth of the bell and melted with a common gasoline blow-pipe. As the metal melts the bell is raised and it runs over the hole left by the wax. This is done for two reasons—first, to keep out any small particles that might fall into the mold, and to give you better access with the blow-pipe until the metal is thoroughly melted "and a little bit more," then, without hurrying, but rather on the pokey order, lay aside the blow-pipe, take hold of the bale, already cold, and get where you will have plenty of room; swing the bell back and forth like a pendulum once or twice and then over your head, like you would a small bucket of water. The plate is cast, of course, the first round, but the swinging should be kept up half a minute, so that crystallization may take place under pressure. All casts made in this manner are better on account of their closer molecular construction.

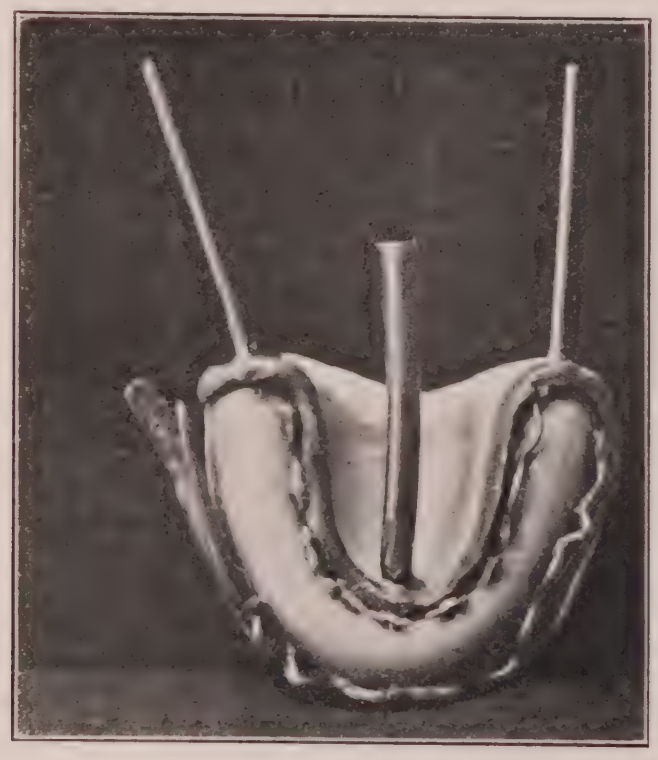
The flask is now allowed to cool and the investment and plate shaken out; the excess cut off with a hack-saw and the plate finished.

The impression can be waxed up or the model scraped down at this point, but it is purely guess work and unscientific. *As a last resort*, when the plate is cast and *still* needs to be *raised* at this point, a plaster model of the plate is poured, and when very hard, removed and scraped down as far as you want the plate. The plate is then placed back on the model and with a ball hammer beaten down to place.

WILSON'S CAST ALUMINUM PLATES

By George H. Wilson, D.D.S., Cleveland, Ohio.

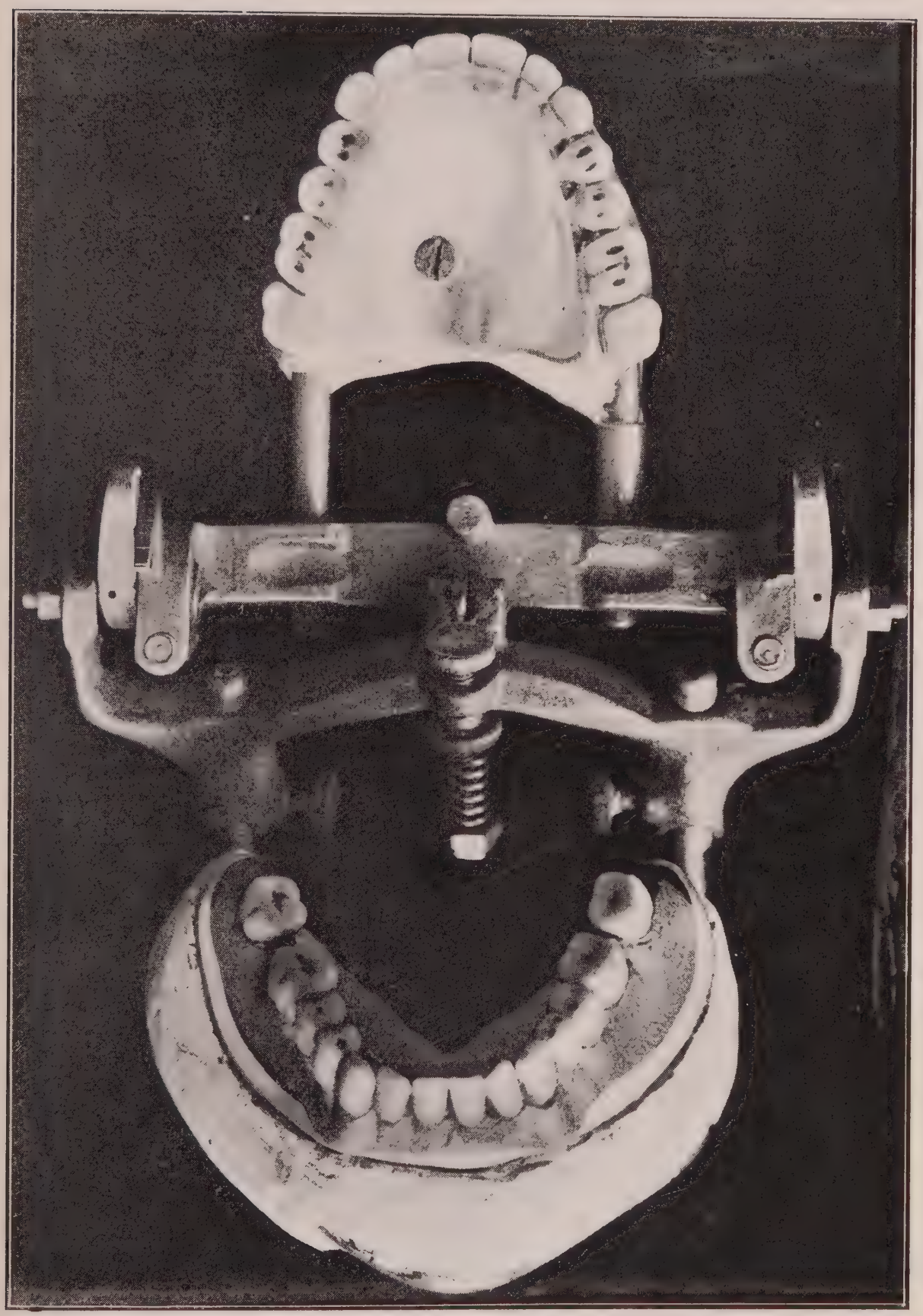
1. Cast of silica sand, wash silica and plaster of Paris, equal parts by measure. Base-plate of paraffin built up with pure yellow beeswax, showing stages of con-



Waxed impression, showing method of waxing

Finished casting

Casting as it came from investment



Showing aluminum cast to teeth on palatine surface

struction; also the sprue formers. The pouring sprue must not exceed 3-16 of an inch.

2. Casting as made in the Billmeyer bucket.

3. Finished pure aluminum base-plate.

4. Complete denture mounted on Snow antagonizer. The upper is cast direct to the tooth. This is not practicable with platinum pin teeth, as aluminum is a solvent for platinum. Attachment of the teeth with vulcanite is the practicable and desirable method as exemplified in the lower denture.

SOME PHASES OF THE CASTING PROCESS

By C. S. Van Horn, D.D.S., Bloomsburg, Pa.

To test a pattern wax hold a piece in the mouth until it assumes body temperature, when, if it becomes plastic, susceptible to change on moderate pressure either by the teeth or fingers, it is not suitable for the purpose for which it was designed. There is a long train of maladies attending the use of a plastic wax that may be largely or entirely eliminated by the use of a non-plastic wax.

Assuming the cavity to be approximo-occlusal, involving all or part of one or more cusps, either of bicuspids or molars, the wax, which has previously been softened in water at 183 degrees F., is quickly thrust into the cavity and molded quickly to place, and the patient directed to bring the teeth into normal occlusion, when with the fingers and proper instruments the buccal surplus is pressed into contact with the buccal wall of the cavity, the instrument being pressed into the interproximal space, thus forcing the wax into contact with the cervical margin of the cavity. As a generous surplus of wax has been used we have a rather uninviting appearing mass, which is soon reduced by rough carving to something like normality. In carving it is of the utmost importance that the pattern remain stationary in the cavity, *i. e.*, without moving and rubbing against the cavity walls; the best way to prevent this is to carve the occlusal surface before disturbing the contact of the pattern with the adjacent tooth. The support given to the pattern by the adjacent tooth, together with properly directed force in carving, enables us to make the most extensive restoration with seldom an appreciable movement of the pattern. After the occlusal surface has been carved, our attention is directed to the lingual margins, then to the buccal margins, and lastly to the cervical margins, all these margins being finished flush with the square tooth-margins for reasons previously described.

We now have a pattern—not an impression—carved to form, except that it has a contact surface—not point—with the adjacent tooth, and is unpolished. The polishing should be done in the same order as the carving: First, the occlusal surface is gone over, touched where necessary with the carving instruments to bring out any artistic lines, and highly polished; then the lingual and buccal margins. Then with a pellet of cotton wet with cold water and held against the occlusal surface to prevent any movement of the pattern, a hot, very thin flat instrument is passed between the adjacent tooth and the pattern, and the abnormally large contact surface converted into a normal contact point, and polished with a wisp of cotton, the teeth having been previously separated, as they always should be, to admit of a subsequent normal contact being formed.

If all the steps have been followed with precision and a high regard for artistic attainment, we have a beautiful restoration of the lost part in wax.

To extricate the pattern an explorer is usually employed, though any of the well-known methods may be used, being especially careful to prevent the slightest marginal distortion. Here again it is of advantage to have square margins where sheltered, for it is manifestly easier to remove without distortion a pattern with square, well-defined margins than it is to remove one with feather-edges. The pattern is then attached to the sprue and examined under a magnifying glass to ascertain its perfectness, and if it is found to be flawless in its marginal impressions any carving which may be deemed essential may be done on the cavity side—and I might say right here that it is seldom that the cavity side of the pattern should not be carved, believing that by so doing we increase the efficacy of the finished product. This carving on the cavity side may be easily and expeditiously done with a light, sharp lancet or a bur in the engine, or a combination of both. The finishing touches being completed, the pattern is ready for investing.

INVESTING

It is just as essential that the investing be properly done as any other part of the procedure. I have noted that some use scales, others measures to apportion the investment and water. I am not prepared to comment on this procedure, except to say that at present I use neither. The investment should be mixed just as thick as it can be and yet admit of the pattern being properly invested, and as it requires more time to coat a complex than it does a simple pattern, it is obvious that the investment should be mixed accordingly. Then, too, some are more dextrous than others, being capable of working with a much stiffer mix. Personal equation being such a potent factor in all our work makes it next to impossible to formulate laws for operative procedures in the field of dentistry.

Ten to fifteen minutes after investing the pattern the investment is, or should be, sufficiently hard to admit of the sprue being removed, which should be done by heating the sprue to a full red heat for several minutes and twisting it out with pliers, thus preventing any distortion of the mold. Remember that we are dealing with the investment while in a semi-set condition, and great care is essential to success.

The flask is immediately placed over a very low flame, a flame of just sufficient heat to drive out the moisture without creating steam, and as soon as the investment is dry the flame is increased and the wax burned out. Formerly, the investment was allowed to dry over night, but I believe this to be at variance with scientific findings relative to the setting of plaster of paris, one of the ingredients in the investment. Be this as it may, I obtain better results by placing the "green" investment over a low flame ten to fifteen minutes after flasking—the castings are just as smooth, just as sharp, and without "feathers."

CASTING

It is obviously impossible to go into extended detail of casting without considering the numerous devices that have been placed upon the market for the purpose, and this in itself would require a paper of considerable length. My advice, therefore, is after mastering cavity preparation and formation, to master the complete technique, and then it is time to master the device with which you expect to do the casting. I fear that a great many have fallen and that more will fall by the wayside by beginning at the reverse end. That which goes to make up the entire casting problem is by no means easy of solution, nor suited to perfunctory methods or desultory application.

At present our work in this field is largely empirical; we have not practiced casting sufficiently long to have established it on a scientific basis, consequently we are too many times between the devil and the azure brine to know the how and the why. Some day the clouds will clear, and we shall broaden our horizon and place casting on a scientific basis. Then we shall have what we have not now, a perfect casting machine, a machine which will be automatic in its action, indicating the exact pressure on the gold in the mold and at the same time the temperature of the metal, just as our pyrometer furnaces indicate the temperature of the porcelain. This together with a perfect pattern wax and a perfect investment material will have a powerful influence in eliminating stumbling blocks in the paths of those not especially adapted or reasonably versatile.

The two most important considerations with the present machines are to determine the requisite pressure and the proper state of fluidity of the gold. Too much pressure will expand and crack the investment, causing an imperfect casting, and if the gold is not sufficiently fluid a sharp casting is not to be anticipated.

No machine of which I have any knowledge will give an exact, sustained, determinable pressure on the gold in the mold, and with the machines of the "plunger" type it is risky, if you have a regard for veracity, to hazard a guess on the pressure. Therefore, no difference what device you use, experiment until you have mastered it, and by that time you will have discovered that the more fluid the gold is at the time when force is applied, the sharper the casting will be.

One way of determining the proper state of fluidity of the gold is this: First the gold assumes a globule, then the "bull's-eye" appears, and finally we get what may be termed the sun-glow. When this stage is reached, if you are watching the gold very closely, you will notice a very slight spreading and flattening of the globule; this is the time to put on the pressure, and if it is done properly, and if 24k. gold in very generous quantity—a quantity admitting at least 5 dwt. surplus—is the metal, you may be reasonably certain of success, though on rare occasions failure will stare you in the face. But, since it is in degree by our failures that we advance, they are not always to be despised but rather viewed as stimulants to subsequent success through fathoming the cause. "If at first you don't succeed." ascertain the cause, for the effect will follow in natural sequence.—*Cosmos.*

THE WORKING MODEL FOR INLAY PRACTICE

By H. W. Arthur, D.D.S., Sc.D., Pittsburg, Pa.

It is not the purpose of this paper to advocate the use of the working model to the exclusion of the direct method of practice in making inlays.

The working model method, aside from the fact that it is not so expeditious, has otherwise all the advantages, as well as supplying the means of overcoming difficulties attending the direct method of practice. In any and all cases, an accurate adaptation to the cavity with contact and occlusion, in bicuspids and molars, as well as the more simple cases, can be assured by the working model method. The working model, while specially to be preferred, for the production of porcelain inlays, meets all the requirements for gold inlays. With the working model as it should be, that is, an accurate impression of the cavity, the approximating tooth and the correct occlusion, the operator, in this class of cavities, has control of conditions and the manipulative procedure in a way that he cannot have by the direct method.

Having the porcelain inlay specially in mind, the following advantages may be claimed for the working model:

The cavity can be approached conveniently from all directions, so that the platinum matrix can be more readily adapted.

The porcelain material can be applied with the platinum matrix on the model, thus avoiding the liability to change of form to which the matrix is subject when held in pliers.

Proximal contact and accuracy of occlusion can be gauged on bicuspids and molars, and more readily attained with the anterior teeth.

Several inlays (there need be no limit to the number) of different shades may be made with but little more expenditure of time than for one, thereby giving a choice of the one best suited to the case.

It supplies the means, in case of an accident, of repeating the operation without annoyance to the patient.

Nicety of detail can be worked out at leisure.

The model, properly registered, with shade record, may prove convenient for future use. Aside, we might add, that the temptation to insert a "good enough" inlay cannot be so readily excused.

The above will apply equally to the gold inlay, where the procedure is in common.

To insure the best results, the working model must be an exact reproduction of cavity and surroundings, as found in the mouth. This necessitates that, not only should the impression be accurate, but that there should be no change of bulk of form. Experience has demonstrated that modeling composition and copper amalgam supply the materials that meet these requirements. Where there is direct access to a cavity, a good impression can be taken by the simple method of shaping the modeling composition to a point and then softening the point. This, with the harder composition to give resistance, can be forced to all parts of the cavity and cavo-surface angle.

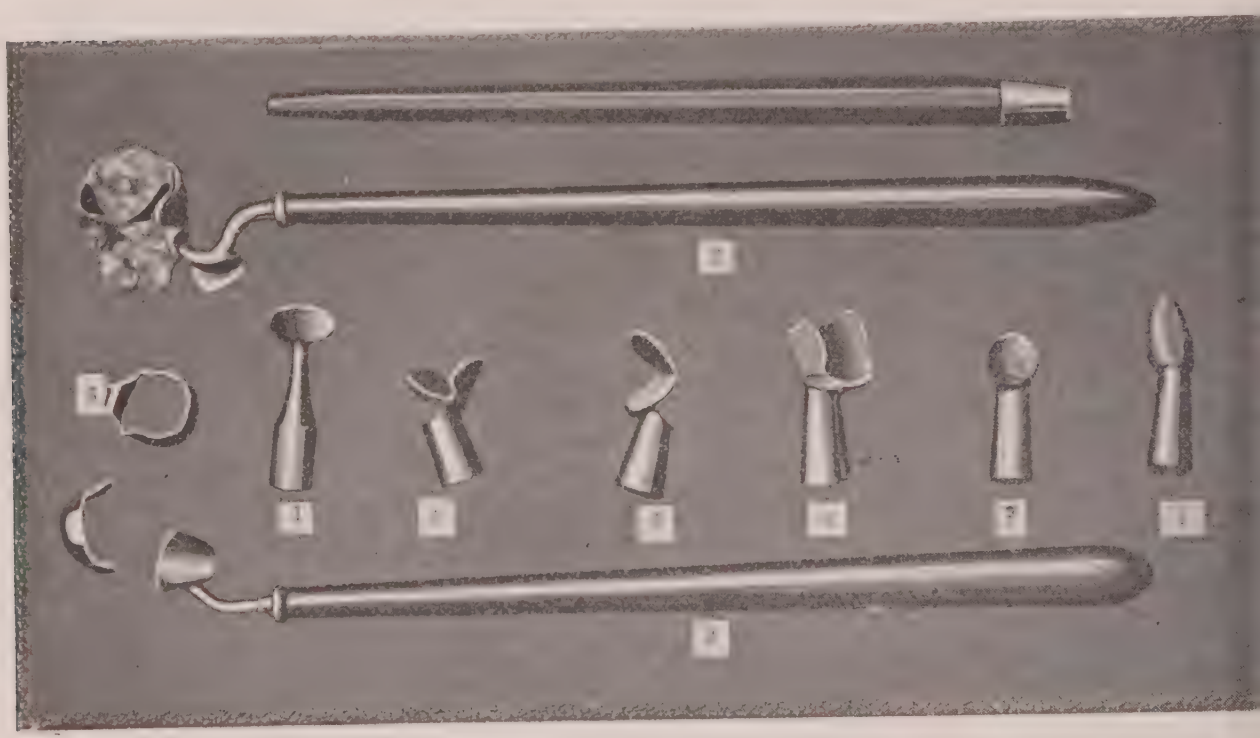
In most cases, however, a suitable cavity tray is necessary to give resistance to force the impression material to the distant parts of the cavity and cavo-surface angle, as at the cervical margins of proximal cavities and under the gingiva-labial surfaces.

To meet these requirements your essayist has contrived a number of cavity trays, described as follows:

No. 1. Designed for taking impressions under the labio-gingival margins of the anterior teeth.

Nos. 2 and 3. Designed for taking impressions (rights and lefts) of the proximal cavities, mesial and distal, of the anterior teeth.

Nos. 4 and 5. Designed for taking impressions of mesio-occlusal and disto-occlusal cavities of bicuspids and molars.



No. 6. Designed for taking impressions where the lingual or buccal portion of a tooth is wanting.

No. 7. Designed for taking impressions of labial, buccal or occlusal cavities.

No. 8. Designed for taking impressions of disto-occlusal cavities of third molars, including the occlusion.

A more recent device has, in a measure, taken the place of Nos. 4 and 5. It is designed not only to take an impression of the cavity, but includes proximal contact and occlusion. So that, mounted on the articulator, we have all the conditions of the mouth.

The device is simple, designed to confine the impression material; can be made in a few minutes. The same appliance has been used by your essayist as a matrix in the operation of filling for years. It consists of a thin piece of sheet metal, shaped to pass above the cervical margin and around the embrasures of the tooth, with a lip turned down to rest on the ridge of the proximating tooth. The appliance, when in place on the proximating surfaces of bicuspids or molars, as the case may be,

should be wedged lightly at the cervical portion with cotton, where there should be a slight yielding, so that the impression material may pass over the margin of this portion of the cavity.

The lip resting on the ridge of the proximate tooth prevents the forcing of the appliance onto the gum when taking the bite. The parts of the appliance passing around the embrasures should be free and yet not enough so to allow the impression material to pass around the embrasures to the extent that it will interfere with the withdrawal of the impression.

Sufficient impression compound should be used to fill the cavity and cover the occlusal surfaces of the adjacent teeth. The patient should be instructed to bite and give lateral motion. With the impression in hand, copper amalgam is prepared for inserting in the usual way. It should be inserted with care, pressed well onto the thin margins, over the impression of the cavity and embrasures, and well onto the occluding surface of the tooth. It is better to wait until the amalgam has hardened before completing the mounting on the articulator.

On the articulator the slight obstruction to exact occlusion, caused by the lip of the matrix, is corrected in the absence of the obstructing lip.

The thickness of the matrix does not interfere with securing the correct proximal contact. The working model should supply all the conditions of the mouth; it has, in addition, all the aforesaid advantages for manipulations.

The appliances we have described are so readily made, and the taking of an impression so simple, that it is well to have it at hand, even though it may only be for contingencies.

Where the occlusion and contour can be allowed, as in the anterior teeth or on exposed surfaces, the copper amalgam counter of the impression of a cavity can be mounted in plaster in a suitable receptacle, thus supplying a convenient means for forming the platinum matrix by the use of the water bag, under screw pressure, and for correcting the shape of the matrix, if need be, after the first fusing of the body in the matrix.

The convenience of the working model for making gold inlays is too obvious to enlarge upon it.

Having as an object the insuring of the best results, as a means to that end, the working model has a place not only in inlay, but in other lines of practice.

ABSTRACT OF DISCUSSION

Dr. Frank L. Wright, Wheeling: I should like very much to have seen a copy of Dr. Arthur's paper. I have never used copper amalgam. I have used Dr. Weston A. Price's method of artificial stone, which is perhaps not as good, but I have had some very good results, especially in proximal cavities between bicuspids and molars. I have made four fillings at one time, using artificial stone; separating a little to get the contact point, and have had results in fillings dropping right into place with a beautiful contact point. The advantage of any model is the almost complete finishing of your filling before putting it in the mouth. You can polish the filling on the artificial stone down to a very fine edge, with little extra work necessary after cementing your filling. The only method I am familiar with is the Dr. Price method. He has different little impression cups for taking impressions. He uses a wax, and the artificial stone is mixed up and put in the wax after it hardens, and the stone does not harden until after heat is applied, and you can make a good model in that way. Your casting wax is then molded right into your cavity, contouring it the same as Dr. Arthur has told us about; and you can get perfect occlusion. Finish your filling, and if you have two or three proximal cavities using his articulator, breaking your model apart. It is nicely adjusted so it can be opened for contouring, graded down to the milometer; spread your teeth just a little and your fillings will go in in very nice shape.

Dr. L. G. Beerbower, Terra Alta: I am sure we have all appreciated this paper very much and

will gain many splendid points from it, but I have not used the method enough, have not endeavored to put it into practice, to discuss it. I know it is a good method from a common sense standpoint.

Dr. Arthur (closing): I have endeavored to put it into as few words as possible and make it as plain as possible. I claim considerable originality in what I have produced there, and I am satisfied when you see it in clinic you will see that it is a valuable means in producing results. That is what we are after.

As to Dr. Price's method, I know of it; have practitioners nearby who follow it up, but think my method is simpler than Dr. Price's and have something in reserve. In Dr. Price's you break up your model, but I have had the impression that in breaking that up you are likely to injure your filling. I regard it as a good method; I wouldn't place this method in contrast with it at all; I am satisfied that it is good and have been prompted to take it up, but have not just done so, probably because of my own scheme.

CONDUCTIVITY OF CAST INLAYS

By S. H. Guilford, D. D. S. Philadelphia

The danger of pulp irritation and often the devitalization from placing a metal filling in contact with a thin layer of dentin overlying the pulp has long been recognized and, in a measure, guarded against by interposing some less conductive substance between the two.

For this purpose different materials have been used, such as a coating of varnish, a layer of paper or asbestos with some adhesive and non-irritating medium to hold it in place, and either alone or in connection with any of the foregoing, a layer of one of the cements.

These have answered their purpose remarkably well in connection with foil fillings but only the last one has been found really available when cast inlays are used.

If the employment of an intermediary is deemed essential under a foil filling in large or deep cavities, an even thicker layer of non-conductive material is necessary under an inlay to insure subsequent comfort and guard against pulp devitalization.

However dense a foil filling may be it is never so dense as an inlay. The former contains a portion of air between its particles and air is one of the best non-conductors. In the latter the molecules are more closely in contact and thermal changes are in consequence more rapidly transmitted.

In this fact lies one of the chief dangers in the employment of the cast inlay. Another fact worthy of consideration is that a gold filling may be removed piecemeal if for any cause the tooth should be sensitive to thermal changes after being filled. A cast inlay could not thus be removed and would have to be pried out with wall fracture as an almost certain result.

We therefore feel that the necessity for providing against thermal shock under cast inlays should be strongly emphasized.

It has been a common practice, in deep cavities, to partially fill them with cement and then give to this material and the adjacent walls the shape necessary for the placing and removal of the wax inlay form. This is a good practice and in many cases has to be resorted to, but it takes time, and delays the completion of the operation.

A better plan, in cases where caries has not made too extensive inroads, is to remove only the softer portions of decay and prepare the cavity so that the wax form will draw, at the same time shaping all margins in the most careful manner just as we wish them to remain.

After the inlay is constructed and ready to insert the inner portion of the cavity is further excavated and prepared in the usual manner. The removal of this last

portion of decalcified material forms a space for the cement to occupy when the inlay is set. But this is usually not enough. The wax form after its removal from the cavity with the sprue-wire firmly imbedded in it should be reduced in size on its cavity side so as to provide greater space for the non-conducting cement.

This is an exceedingly delicate operation owing to the danger of distorting the form and rendering it useless. To trim it with a cold spatula or bistoury would necessitate the application of too much force. A heated spatula would be liable to melt too much of the wax and cause it to flow and ruin the form. Heat, however, seems to be the most available medium for the purpose if some means be provided for carrying away the wax as fast as it is melted. For this purpose a couple of devices have been placed on the market consisting of a handle with a bulb or receptacle near its outer end and a metal or glass capillary tube leading from it. The handle is hollow and connected with an exhaust pump of some form.

When the bulb is heated the free end of the small tube is applied to the portion of the wax form to be removed and as it melts is drawn by suction through the tube into the bulb where it is absorbed by the cotton.

A device of this kind serves its purpose admirably but it lacks simplicity. An equally efficient method, but far simpler, has been suggested by someone and adopted by the writer. It consists of an old excavator from which the point has been broken and the shank slightly roughened with a file. If cotton is wrapped in a spiral about the point for half or three-quarters of an inch and the shank heated some distance farther back, the point, when applied to the wax form, will melt it and the cotton instantly absorb it.

In this way, with deft handling and the occasional renewing of the cotton, any quantity of the wax form may be removed, and any shape given it. In fact, the wax which is usually convex on its under side, may, by this method, be made concave or partially hollow, which will not only materially lessen the amount of gold used, but also aid considerably in its retention.

The main object, however, in removing a portion of the wax form is to provide space for a greater quantity of the non-conducting cement.

The writer has also found it of advantage to groove the wax form for retention purposes instead of doing it later on the cast inlay. To do it after the gold has been cast is a delicate operation sometimes resulting in twirling the small piece out of the fingers onto the floor and occasionally wounding the fingers when a small circular saw is used.

Grooves are easily cut in the wax form, if the sprue-wire is firmly attached to it, by drawing a fine excavator along the surfaces to be undercut. A fine bead will be raised on each side of the groove but this is easily removed from the gold surface after casting.

With the rapidly extending use of the gold inlay, improved methods of removing surplus wax from the form and of grooving its sides will probably soon be evolved from the brains of the many who are concentrating their thoughts upon the further development of this most valuable method of tooth preservation and restoration.

—*The Garretsonian.*

METHOD OF REPRODUCING FLOWERS, INSECTS AND THE LIKE BY CASTING

By T. C. Hutchinson, D.D.S., Decorah, Iowa.

As time goes on the science of art and invention are making rapid strides towards producing wonders in the mechanical line, all for the benefit of man, to aid him in accomplishing work more rapidly, in doing it better, and at the same time making work easier on the man. This is certainly an age of invention and the dentist who thinks that he knows all about the casting of inlays, crowns, etc., has yet something along these lines to learn.

With the invention of casting, as brought out by Dr. Taggart, the dentist does his work more rapidly and in the hands of the average man, more perfectly, than by the use of former methods of accomplishing the same results. The dentist has more time in which to rest and occupy his time with things of interest, and the writer knows of nothing that would give him all of this, better than the making of metal

flowers, etc. To practice this work you will not only find pleasure in the work but you are bound to learn something relative to your work in casting plates, etc. The illustrations here presented of the cast figures will give you an idea of its possibilities.

In a few words I will tell you how to go at it: Take any flower, no matter how delicate it may be, and immerse it in a mild solution of sandarac varnish, shaking the surplus off by taking hold of the stem; then mix the investment material, and with a camel's hair brush paint the top of the petals as you would your wax inlay. Next, if it be a flower of several petals, pour some of the investment material in the palm of your hand and lay the flower in this and pour more investment over it; jar your hand and the investment will fill up all of the interspaces. (Note that the coating of sandarac attracts the moisture of the material.) Having poured some investment in the bottom of your flask, take the partially invested flower by the stem and lay in the flask and then pour the flask full. Use the stem of the flower for the sprue. Make the crucible form for your metal the same as for inlay work.

In burning out the flower, which is placed as close to the bottom of the flask as possible, put your blast heat on the investment instead of the flask. You will have to make a cast flower to learn how to ascertain the time required to burn it out. With the heat directed near the flower one should not consume much more time than it would take to burn out the same amount of wax.

SOME MORE PROGRESSION

By R. C. Brophy, M.D., D.D.S., Chicago, Ill.

The dental profession is a progressive body. It may be that some of its members did not vote the Bull Moose ticket at the late election, but it is probable that if they did not, they voted for Mr. Wilson through a belief that he is just as progressive as is Col. Roosevelt.

Especially are dentists, as a body, progressive in considering new ideas pertaining to practice. Very few innovations are introduced that are not followed by a general looking up and taking notice, and a general manifestation of a purpose to investigate; but when a new idea has been tested and found worthy of adoption, they exercise no less progressiveness in acquiring the best facilities obtainable for the application of that innovation in their work or practice.

It has been observed by a good many, however, that while dentists are actuated in their progressiveness in adopting new methods of practice by a desire to subserve

the best interests of their patients, when it comes to the matter of doing the work their progressiveness is actuated by pure, all-wool-and-a-yard-wide selfishness. For instance, Dr. J. C. Y. Moore, of Aurora, Ill., believes, with a great many of his brother dentists, that the best way to conserve the interests of patients who have decayed teeth, in a large percentage of cases, is to make and insert inlays in the cavities, and he does it.

Dr. Moore, one day, made an inlay, and was intently at work finishing it to the degree usually considered before insertion, when it flew from his fingers and alighted through an aperture of a floor register. Dr. Moore, just at this time, began to forget about his patient, and commenced to think about Dr. Moore. The inlay was recovered. It was a small inlay, and as Dr. Moore pinched it harder and as the little disc played upon the inlay and upon Dr. Moore's thumb and finger in a mutual manner, he thought more and more of Dr. Moore. The patient was forgotten wholly, brotherly spirit lay dormant in his breast, and no thought of even floor registers or sore fingers, other than his own, entered or emanated from Dr. Moore's mind; but the idea was then and there born therein that he would try to make some

kind of a holder that would hold Dr. Moore's inlays while being finished. Dr. Moore did set about it, and the process of evolution finally developed a perfectly practical instrument, an efficient little device for that purpose.

It was a clear case of progress being pushed ahead by pure, unbridled selfishness. No consideration of the uplift or maintenance of patients' interests nor of anyone else's interests save Dr. Moore's, had a thing to do with the pushing.

As a matter of fact, the latent disposition of Dr. Moore to be of service to his brother practitioner by offering to let him share the benefits of his instrument would have continued to sleep had it not been for the persuasion of the writer.

It would be all right sometimes, and, as a matter of fact, would be better lots of times for a man to hide his light under a bushel, but it is positively wrong for a member of the Christian-spirited profession of dentistry to keep as good a thing as Dr. Moore's inlay vise out of the hands of his professional brother. He might let him chase the festive collar button down his back, under the dresser, or any other place, but he should not let him chase the inlay, if he can prevent it, as Dr. Moore can do.

The cut shows the two styles of Dr. Moore's vise. The one at the right comprised by his willing but inappropriate fingers, which he condemned, and abandoned, and the one at the left, much simpler in construction, yet excelling it in every essential, which he has substituted therefor.

It is unquestionable that dentists feel that if they had an instrument which would hold inlays of every size and every form in a perfectly rigid grasp on the end of a handle nicely fitting the clasped hand, and thus holding it without contact with the fingers or obstructing the view, operate upon the outer surface and margins, a long and urgent need would be met.

Having been instrumental in getting Dr. Moore to make his instrument available to the profession, I am writing this because I regard it equally important that attention of the profession be called to it.

HOW TO OBTAIN A SMOOTH, DENSE SURFACE ON CASTS

By F. L. Olds, D.D.S., Toledo, Ohio.

To insure smooth, dense surfaces on plaster casts, also on casts made of investment materials, we recommend that impressions of all-plaster be used; or, if modelling compound or wax be used, that a thin layer or coating of plaster be applied to the surface of the impression.

To prepare the impression for pouring a model of model-plaster (New York plaster), for vulcanite work, first give the impression a thin coat of shellac varnish. When this has become dry, which it will in about thirty minutes, give the impression a thin coat of sandarac varnish. This also should be given time to harden, about twenty minutes, after which we place the impression in water and allow it to become saturated before pouring the model. As an experiment, take any piece of plaster that has been lying around the laboratory for a few hours, and put it in water; bubbles will rise on the surface very freely, even through a varnished surface. Now, if freshly-mixed plaster or investment material were placed in a dry impression, the same thing would occur; bubbles would come from the surface of the dry plaster and a model full of holes, forced in by these bubbles of gas, would be the result. The reason for using the varnishes, as stated, is that the shellac acts as a filler on the fresh plaster surface, just enough being used to fill the pores and stain the plaster to a slight depth, leaving the surface, so far as the fine lines of the impression are concerned, just as it was before varnishing.

If the impression were to be poured at this stage, with just the shellac as a separating medium, there would be difficulty in separating, as the plaster, in setting, creates enough heat to soften the shellac and thoroughly glue the two parts together.

Some are in the habit of using oil or soap to prevent this sticking together of the impression and model, but this is not good practice, as the oil or soap will unite with the fresh plaster, and a very poor surface on the model is sure to be the result. So we use sandarac varnish, thin sandarac varnish, as a second coat on the impression. All that is needed is just enough to give a smooth, glossy surface. We prefer a colored varnish, as it is easier to ascertain just how much is being used.

When the varnish has hardened, place the impression in water and leave it there until saturated, so that no bubbles of gas will rise up and fill the surface of model with the holes that we all have seen, and so that the dry plaster will not take up some of the necessary water from the fresh plaster, and give us a porous surface of poor quality.

Sandarac varnish is practically inert so far as the pouring of impressions is concerned and can be separated by carving away the impression over the ridge until the stain made by the shellac appears; then place the point of a knife under the edge and gently break away from undercuts and around teeth.

After separating the impression, the first thing to do is to give the surface of the model a good coat of castgloss, or silex, before anything else gets onto the surface.

Hot wax or grease of any kind, if run over the surface before applying silex preparation, will prevent the plaster from taking up the silex, and a rough, porous surface on the palate of the plate will result.

After applying castgloss, wipe the model dry with a piece of cotton, rubbing hard enough to polish the surface somewhat. Hot wax or any other material may now be run over the surface of the model, and the plate will still come out with a smooth, clean surface.

For models of investing material for casting, we prepare the impression the same as above, with the exception that whatever relief is desired for the case should be carved in the impression; and if it is necessary to fit the plate a little closer at the periphery, just add a little wax to the impression, as the model cannot be carved when made of investment material without making a rough surface. The surface of a model for casting should be left just as it comes from the impression, without any alterations whatever.

The surface of any model will be just as smooth as the surface on which it is poured. If plaster is poured onto glass, a glassy surface is the result. If poured on a rough surface, the surface will be rough. Therefore, to have smooth models we must have smooth impressions, and the impression must be treated so that it will be practically inert so far as the pouring of freshly-mixed plaster or investment is concerned.

CASTING, WITH SPECIAL REFERENCE TO CASTING ON PORCELAIN

By W. C. Gillespie, D.D.S., Nashville, Tenn.

The process of casting metal under pressure has opened the greatest field of possibility for saving and restoring teeth that the dental profession has come into in many years. The casting machine stands next to the dental engine in line of improvement in dental equipment and in variety of uses to which it may be put.

There are countless numbers of devices for casting metal under pressure, but all are variations of four basic types—those that utilize centrifugal force, suction, compressed air, or steam pressure.

The application of pressure casting—a very old process—to dental art will raise the general average of tooth-saving ability, practical merit, and artistic product of the profession because it will enable the less skilful practitioners to form in plastic substance and reproduce in metal better dentures than they were able to do direct in the more refractory substance.

Casting is neither an experiment nor a fad; neither can it be conducted on the nickel-in-the-slot basis. A few porcelain facings or teeth and a little scrap gold dumped into the machine before you go to dinner will not be a beautifully finished bridge when you return. Brains are as essential to successful casting as a properly constructed casting machine and necessary materials.

The limitation of the application of casting depends entirely upon the ingenuity and skill of the one who employs the process in constructing dental restorations. By this means anything of which a mold may be obtained may be reproduced in metal with ease.

Castings consisting entirely of metal, such as inlays or all-gold bridges, may be produced; or gold may be cast directly in contact with porcelain surfaces without a previous adaptation of backing. A simple inlay or a six-tooth bridge may be cast with the same ease and same amount of labor in so far as the casting is concerned.

The amount of time required to cast an inlay may be as long or shorter than would be required to condense foil in the same cavity; but the physical labor is not a tenth part so strenuous, and the patient will rise up and call you blessed. More patients may be seen in a day, because when the wax model is obtained the patient may be dismissed and the casting made when there is nothing else to do.

The advantages of cast gold over welded gold are too well understood to need comment, and where the inlay is preferable to a condensed filling depends entirely upon conditions to be met in each case.

The time required to construct a bridge by the process of casting is very much less, as a rule, than that by soldering, and the time and labor are just as much less as would be necessary to do the things avoided by the process of casting—namely, greater amount of grinding porcelain bodies, backing, making dies, swaging cusps, waxing cusps in position, coaxing solder to go where you wanted it and grinding off the excess solder you knew you did not need but were afraid not to put there.

The time required to wax up, invest, dry out, and heat up is the same for either process; but the actual casting requires much less time than building up the amount of solder would do.

Grant, for the sake of argument, that the *time* required by both processes is the same for a given case, the results obtained, labor and material saved, and avoidance of fatigue and discomfort to the patient place casting far ahead of condensing fillings and soldering crowns and bridges.

The dentist who casts only inlays is certainly blind to the possibilities of a simply wonderful and wonderfully simple process which he is employing only in its most insignificant application, as valuable as the process of casting inlays may be. And the dentist who does not cast at all is either utterly non-progressive or too cautious for his own and his patient's best interests.

The process of casting, intelligently employed, is thoroughly applicable to the construction of shell crowns, all-gold bridges, retaining appliances for regulations or pyorrheal teeth, porcelain-faced crowns, bridges wherein porcelain facings, ordinary rubber-plate teeth, diatoric teeth, saddle-back teeth, removable-pin crowns, or Logan crowns are employed for abutments and dummies and for adapting Logan crowns to roots.

Any type of porcelain tooth may be cast upon without backing, but care should be exercised not to use a tooth with pins soldered in position or a pin of composition metal that might have a fusing point below that of gold.

Backing as employed in the old process was to give a surface upon which solder would flow evenly and not ball up. It had little to do with the prevention of checking of porcelain, however contradictory that may sound to the teachings and accepted theories of the past. A direct contact of porcelain with heat or flame will not cause checking, provided the cold body is not thrust suddenly into a flame or furnace, but is permitted to heat gradually at first. It may then be carried to a degree considerably above the fusing point of pure gold; and if allowed to cool gradually, no checking will occur, though this be done repeatedly.

Borax never yet caused a piece of porcelain to check, except indirectly; yet this statement would be regarded as damning heresy by the old masters. These things I have proven by hundreds of tests and experiments during a practice of nine years and four years' experience with a porcelain furnace. While writing this paper I have had in my electric furnace an ordinary plate molar tooth, a Logan crown, and two diatoric molar teeth, which were rolled in damp powdered borax and placed in the furnace covered with a layer of borax, and the hole in the diatoric teeth filled with it. A nugget of pure gold was placed with them and fused, and the teeth came out without a check, but were most beautifully glazed on surfaces that had been ground with a stone. The borax may unite with the porcelain and cause it to become more brittle if carried very high, but the experiment is cited in proof that it does not directly cause checking.

Checking of porcelain is more often caused by unequal expansion and contraction than anything else. This is due to lack of uniformity of distribution of heat or the sudden heating or cooling of the surface or part of the porcelain body. Different degrees of heat produce different degrees of expansion and the surface or some portion of the body of porcelain heating or cooling faster than the interior or some other portion of the mass; and porcelain being a low conductor of heat, an unequal stress is set up that is relieved only by fracture.

Fracture is also caused by permitting molten solder in soldering or molten gold in casting to flow around an edge, and in the contraction of cooling a grip is set up that will break any porcelain made. Such fracture is due to improper waxing up of the case for either soldering or casting.

It is also claimed that a metal pin in a porcelain body—such as the post of a Logan crown—will expand faster than the porcelain, and thus cause fracture. That claim sounds plausible, but is little more than sound, for a degree of heat that would expand the metal sufficiently to do that would have already fractured the porcelain by suddenly expanding the surface. Also where there is a post baked into a tooth heat will be conducted into the center of the mass by the metal as well as being absorbed by the surface, and the distribution will be more uniform than if the post were not present. If the heat were applied to the post directly and conducted to the interior of the porcelain while the surface received a much lower heat, then the expansion of the post and the layer of porcelain surrounding it would be faster than that of the surface, and fracture would result. But to do that would require considerable trouble to bring about something nobody wants.

The fractures indirectly caused by borax are brought about by a union of borax with the porcelain, causing it to lose its elasticity and become more brittle, as is the case when gold is alloyed with some base metals. This loss of elasticity renders it less capable of resisting the stress of expansion and contraction, and a slighter inequality of temperature will cause a fracture, than if the integrity of the porcelain had not been impaired.

An inlay or all-gold casting of any nature may be successfully cast in a comparatively cool or a cold mold, as is proven by castings of iron and brass foundries. But to cast upon porcelain without fracture the mold must of necessity be brought to such a temperature that the porcelain bodies contained will be subjected to no undue strain of unequal expansion by sudden contact with molten gold of much higher temperature.

The investment ring is readily raised to a red heat; but investment material is a low conductor of heat, and several minutes will elapse before the heat is distributed throughout the mass. So, unless sufficient time is given, the porcelain in the mold will be several hundred degrees cooler than the surface, and the molten gold forced into the mold will fracture the porcelain just as cold glass fractures by sudden contact with hot water. Get the porcelain in the mold thoroughly hot and you may cast all the gold on it necessary for any denture ever put in the mouth, and the tiniest facing will never be checked if properly waxed and invested. No flux is needed for any cast, and borax when fused is very sticky and, uniting with the investment, interferes with the entrance of gold into the sprue-hole.

Logan crown joints may be fitted as accurately as the margins of inlays, and thus they become the most perfect crown restorations known to the profession, and may be perfectly adapted to roots far below the gum line all around or at any point. Molar stumps in the same condition may be easily and beautifully restored the same way by placing a pin in each canal and using plate teeth with pins baked in or diatoric teeth. No fear need be had in casting into diatoric teeth, for the molten gold enters the recess in them at its maximum expansion, and the contraction upon cooling makes the post thus formed slightly smaller.

Removable pin crowns, such as Justi's, the Davis, etc., have no lateral openings, as have the diatoric teeth; consequently the molten gold will not enter and completely fill the recess provided for the pin because there is no avenue of escape for

the air caught in the recess. It, therefore, is better to remove the crown from the wax before investing, and the porcelain need not be subjected to heat at all, but may be cemented on the post after the gold that perfects the adaptation to the root has been cast onto the post.

To use such crowns for dummies, clip the post off to the desired length, insert in crowns, wax crowns in position, chill with ice water, slip crowns off posts, cast, and cement crowns in place, and you have a most beautiful and practical case. Crowns and dummies thus constructed are far less apt to break away than those backed and soldered, for they are supported by perfect contact of gold at every point, while a backing touches only here and there, and their retention depends almost entirely upon the strength of the pins baked into the porcelain. And if one should break, grind up and cement another on the post left standing.

Pure gold should be used for inlays and 22-karat gold for everything else. In casting inlays and shell crowns do not waste gold by casting them unnecessarily thick. Hollow inlays are easily made, a much stronger retention is secured, and a greater thickness of cement protects the pulp from thermal irritation. There is on the market a device consisting of a hollow metal bulb, with small extending point, through which a hole extends back to a tube to which is attached a rubber tube with a mouthpiece. This end is taken in the mouth, the metal bulb is heated, and when the hot point is touched to the surface of the wax model to be hollowed out, the melted wax is instantly sucked back into the bulb, leaving edges as clear-cut as if cut with a knife. The same thing may be done with an ordinary hot-air syringe or chip blower having a bulbous nozzle. Solder to the nozzle the shank of a hypodermic needle, having bored out the needle with a small drill. Connect the rubber bulb to the metal tube with six or eight inches of rubber tubing, so the bulb may be worked with one hand and the metal point directed steadily with the other. Mount the wax model of the inlay on the sprue-pin fixed in a base to hold it steady, and then with the point heated suck out any kind of undercut or hollow you desire.

This is but a small part of the merits and possibilities of the process of casting as applied in dentistry; but too much time cannot be taken up with one writing.

—*Dental Headlight.*

REMARKS ON CASTING

By Robert N. LeCron, D. D. S., London, England

At the present time the cast plate seems to hold the center of the dental stage amongst the recent reproductions in metal, especially in England, where plate-work flourishes to a greater extent than in any other country. Hence, those interested in the experimental stages of casting are called upon to answer many questions as to the reasons for this, that, and the other regarding the results, possibilities, and the future of the cast-plate.

This branch of the work still being in its infancy renders some of the questions asked practically impossible to answer. We can only hope to arrive at definite conclusions after a long series of experiments along practical lines, not alone from a demonstrator's viewpoint but from conclusions based upon practical work in the mouth of the dentist himself. Casting under pressure is ancient, yet it is a new idea as applied to dentistry today, and like all new things, is being worked to death, just as porcelain work was misapplied in many instances; but like all things abused it shall find a place amongst the branches of dentistry according to its merits as tested by time.

The echo from all sides seems to be complaint as to the casting of thin gold plate. It seems strange that so much stress should be laid upon the idea of a *thin* plate. True, in the case of gold the thin denture is that which is desired and necessary, but, nevertheless, it is curious that a thin gold plate, full or otherwise, should be the source of so much trouble and comment, when some of the following details are taken into consideration. From a casting standpoint only, the thicker the plate or the more bulky the object to be cast, the greater the air space or cushion within the mold to get rid of, after the wax or object has been burned out and the greater the amount of metal necessary for the casting of same, and in like proportion the greater the surplus metal required, consequently a greater heat must be used to melt this bulk of metal and a still greater care to see that it is not only molten but in a proper condition to flow into a mold. Then too, the greater the mass of molten metal over the gate openings,* especially with gold or any of the heavier metals, the greater the liability for that metal to sag or even flow into the gate or gates before the pressure is applied. Hence, the thinner the plate or the object to be cast the less the difficulties and the easier and more certain the result.

One of the most important factors in casting, regardless of the method used, whether it be by gravitation or by pressure, is the getting rid of the air from within the mold quickly and with the least possible resistance to the escape of that air, as the molten metal enters and spreads to the remote parts or crevices of the mold.

While watching various demonstrations on casting, I have heard the question asked and have been asked many times myself: What becomes of the air cushion within the mold? Demonstrators must have an answer ready at all times, otherwise they are liable to find themselves in an awkward position. Some insist that upon heating up the case the air within the mold becomes rarified—and so it does; but not to the extent of producing a vacuum, as sometimes implied, or anything approaching

*The words gate, lead and runner in this article are used to express what is generally termed sprue

such a highly rarefied condition. If it were possible to produce a vacuum—the casting apparatus with the method of melting the metal in a crucible directly over the gate openings would be practically useless. If such was a fact, upon melting the metal upon a flat crucible-like surface of one of these highly heated cases, one would naturally expect bits of the molten metal to be drawn into the mold as parts melt and fall away from the yet unsettled portion, instead of melting gradually and remaining in a liquid mass over the gate openings, until a positive pressure be applied.

Perhaps the above is the cause of some failures, where the case is heated until it glows red from within through the gate openings. In speaking of extensive castings where fifteen or more hundredweights of heavy metal are used, capillary contraction is not sufficient to cause the molten mass to globulate to any great extent, far less overcome the suction from beneath, caused by the supposed vacuum within the mold.

The air surrounding the molten mass becomes more and more rarefied, it is true, as the intensity of the heat increases for melting purposes, and no doubt, theoretically overcomes and counteracts the vacuum within the mold, which space has had a greater or less opportunity to cool while melting the ingot. (At least, this is one explanation set forth.) If the above be a correct theory, the question then arises: Why, if the mold be ventilated, is the molten metal more liable to sag into the gate openings, or to actually flow into the mold without the application of pressure providing the mold be sufficiently vented than in a case where mechanical vents are lacking?

For instance, before Doctor Taggart conceived the idea of casting as it is now applied to dentistry, some were casting into matrices. Shortly after this method was given out, but not known in detail to the profession generally, many more were experimenting along these lines of gravitation.

This method is known to all and simply consists of a mold with a vent leading from the same to the outside of the investment, and a large gate opening into the same. The metal, instead of being melted over the gate opening, was melted in a crucible to one side with a lead or avenue to the large orifice of the gate opening. As soon as the molten metal was in the proper condition to flow, the case was tipped to one side allowing the metal to flow into the gate or runner and gravitate thence into the heated mold. This method was applied only to small castings, and the success of the same depended not only upon the thorough heating up of the case, a large gate and plenty of metal, but also upon the vent opening to allow for the escape of the air from within the mold. These cases were heated extremely hot, yet the rarefication of the air within the mold thus brought about was not sufficient to secure a perfect result in any instance, unless there was a vent from the mold to the outside. One realizes quite readily how difficult it is to pour water or any liquid into a bottle or closed flask where the air contained within must escape from the same aperture through which the liquid is being poured. If, however, there be another outlet to the atmospheric pressure within the flask the procedure is quite simple.

With castings such as poured by the working jewelers in cuttle-fish bone, and those on a larger scale in foundries into molding sand, some of the important details are as follows: *Sufficient vents, a large runner*, depending on the size and the complication of the casting in hand, and *sufficient bulk of metal in a thoroughly molten condition to flow.* At least, these were the prime factors most impressed upon my mind while taking a course in a molding shop. All necessary on account of the mold being cold, and the flow of the metal depending alone upon its own weight and surplus behind

called the runner and sufficient access to all parts of the mold to enable the liquid mass to spread quickly to all parts without interference from the air within.

Though a mold be well vented, if it be filled from the top the casting is liable to be full of blow holes. In such cases dense castings may be obtained by giving an extra length at the top of the mold away from the runner—the unsound portion being thus formed in this extra length and cut away afterwards as the deadhead.

In casting a metal under pressure, the conditions are different and allow and necessitate certain changes or deviations from the old method: however, it is always well to bear in mind the law of gravitation and the details governing cheoplastic art.

On account of the metal being melted in a crucible, directly over the opening or lead into the mold, instead of pouring the liquid mass into a runner—this lead or gate must be much smaller in diameter. If too large, the metal is liable to sag into the same; if too small, the construction offers too great an obstruction to the flow of the metal. With small castings, it is remarkable what a small gate opening the metal may be forced through.

I have been trying to determine by a series of experiments, not yet completed, the *size*, *length* and number of the gate wires necessary for the various castings in the different metals; for each metal allows of a different treatment. With aluminum or any of the lighter metals, most any size gate seems to answer the purpose; but as there is no tendency for these metals to sag, a very large gate will be found most useful. The heavier metals in large castings require more care in the selection of the gate wires; with such metals as tin and Watt's metal that melt at a low temperature and remain liquefied for some considerable time, smaller gates may be used than with the same case in gold that solidifies quickly.

If attempting a large casting in gold through one lead, there is an influence towards using a large gate wire, thereby rendering a failure more possible. Hence I prefer to use two or more smaller gates leading to various parts of the mold to minimize uncertainties. Casting a metal into a mold in a bulk is quite different from that of casting the same quantity where it must spread for some distance from its entrance into the mold.

In short, with the data to hand, I can but say that I adhere to the following details as nearly as possible until I satisfy myself more fully on this subject, *i. e.*, the heavier and the greater the bulk of the metal to be used with the exception of tin and Watt's metal and similar metals and the thinner the object to be cast, the smaller the gate openings and the greater the number of the same radiating from a common center to various parts of the mold, and last, but by no means least, the flatter the crucible or surface upon which the metal is to be melted.

Certain stress has been laid upon the subject of ventilation, yet a few more words may be added. There are many methods whereby this important procedure may be accomplished. With small work, the porosity of the investment should be quite sufficient. By the word small I not only imply inlays, but crowns, bridges—in fact, any design within the radius of two and a half inches. Larger objects may be cast relying upon the same escape for the internal gases, in which cases the procedure of investing is an important detail, *i. e.*, to be certain that the distance through the investment from the top down to the mold is greater than the distance from the mold down through the base, and where the metal must flow for some considerable distance from the entrance of the gate openings into the molds, to be careful that these remote parts be *quite* near to the base, so that as the metal enters and spreads to those distant parts the air confined therein is forced through but a very

thin layer of investment to the outside of the cup; and the pressure from above has little chance of driving air through the thick investment over these parts before the metal spreads to the same.

The air within the mold is either taken up by the investment similar to a sponge, absorbing water, and like the sponge, it has a limited capacity, after which the remaining air must be driven through the investment to the outside or remain within with the liability of causing blow holes by reacting upon the molten mass or defects by not allowing the metal to spread. Any air driven out into the investment is driven there under pressure; hence to further assist the escape of internal air or gases I find it quite convenient to perforate the lower strata of investment through into the mold with a fine, smooth broach before the wax or object is burned out. To leave these mechanical vents open is liable to cause trouble if a heavy metal is to be used; by rubbing some of the surplus investment over the base these holes or vents may be temporarily stopped to hold the air cushion within, which in turn prevents, along with other details, the metal from sagging into the open gate while being melted. As soon as the pressure is applied for casting, these slight stoppings blow out, leaving open rents through which the air may pass with the least possible resistance.

If there is any one detail in the mechanical process more important than another, I should say that it is the melting of the metal. There is a certain condition of a molten metal at which that respective metal will cast to the best advantage, *and it is not the boiling point.* Any ordinary blow-pipe may be used that will, with the proper manipulation, melt the metal quickly with a strong blue flame; in no instance should a large smoky flame be used, for it only tends to oxidize and spoil the working of the metal. Once the metal has been melted, one should not be too anxious to cast, but should employ a small soft flame for a short time upon the already molten mass until certain it is in the proper condition to flow into a mold. Take, for instance, in the ordinary casting of zinc and lead for dies, etc., considerable care is taken that the molten metal is not bubbling from being too hot and, on the other hand, not sluggish from being too cold before pouring. If the metal be in the proper condition one need not be in a great hurry to apply the pressure, for it will remain in a liquid form some considerable time.

In conclusion, simply because the molten metal is to be driven by force into the mold is not sufficient reason for being careless about the melting of the metal, even in such simple castings as inlays, and yet expect an apparatus of any description to duplicate perfect castings under such adverse conditions.—*Dental Brief.*

PLATE CASTING BY THE VACUUM PROCESS

By W. L. Harpel, D. D. S., and F. L. Olds, D. D. S.

The first step in plate casting is to obtain a perfect plaster impression. All relief-work necessary must be done on the impression, because the model cannot be altered after pouring.

When the impression has set, apply a coat of Separlac, filling the pores of the plaster, thus producing a smooth, glossy surface. Twenty to thirty minutes should be allowed for drying the varnish.

All air must be expelled from the impression. To do this, place in water and allow it to remain there until bubbling stops.

Models should be made from Imperial Investment Compound. There may be other good compounds obtainable, but we know of none that compares at all with Imperial for the making of models. The cost is so trifling that it is not worth while to experiment.

The proper mixture is one part water to four parts investment. See that the mix is thorough. Chemical action must take place within every atom of the investment. Do not beat or stir the mixture violently; spatulate it gently but continue until a thorough amalgamation has taken place. Otherwise bubbles will form and the cast cannot be satisfactory.

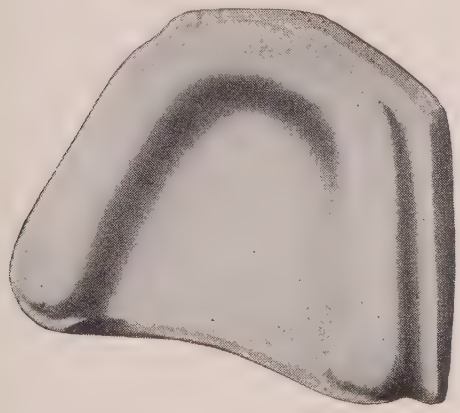


Plate 1—The Finished Model

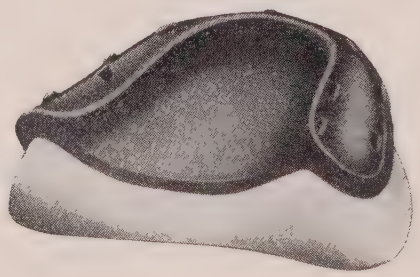


Plate 2—Model Waxed

After the model has been poured and allowed to harden, requiring ten to fifteen minutes, separate and trim as thin as can safely be handled, allowing flanges to project as shown in illustration. The smooth surface of the model must be maintained; therefore do not attempt to make any alterations on the model. A little Canton graphite rubbed over the casting surface of the model with the finger will add to its smoothness, and insure a bright, polished surface on the cast.

Thin base-plate wax is to be adapted to the model, allowing it to cover it a little higher than the plate is to be when cast. In trimming the sheet, be guided by the height of the plate, both buccally and labially. Use a wax that does not become quite brittle when cold. A light-colored translucent wax is to be preferred. Do not use highly-colored or dirty wax, as it is sure to leave a residue when removed by heat; likely to cause holes in the plate.

Wax must be carefully sealed to model all around with a hot spatula; otherwise investment may work in between the wax and model.

Lay a ruler, with beveled edge, the long way of a sheet of wax, and with a warm knife held against the edge of the ruler at an angle of 45°, cut strips of the wax $\frac{1}{8}$-inch wide and full length of the sheet.

Warm the strips of wax slightly, and lay around buccal and labial edges of wax base where the pencil mark shows through base plate, to form outer rim. Turn around heel of plate over tuberosities and around palatal portion to form inner rim. These strips of wax will meet at center of plate. Seal strips down with a hot spatula and a little extra wax.

The beveled edges of the strips must be placed next to the surface upon which attachment is to be made. See that the wax rims thus formed present perfect under-cuts. Cut small lugs of wax and place them where they will give best attachment, or the metal may be spurred or picked for vulcanite attachment after casting.

Cover wooden-sprue-block with a thin coating of wax to facilitate removal from the investment; cut four strips of base plate wax, one-half to three-quarter inches long and three-eighths wide and attach to wooden sprue-block in such position that one will connect with the wax base plate at each of the tuberosities and the others palatally to form gates. This wax should be of same thickness as that used for the plate.

To determine the distance of sprue-block from wax model, place model on flat outside surface of flask and within one-half inch of bottom or small end, and attach wax strips so that sprue-block will be even with top of flask.

The gates should not exceed three-eighths inch in width, as , if wider, the metal may be carried down by gravity before the valve is opened, spoiling the cast.

Place model with wax base and sprue-block in water and let it soak until all bubbling has stopped.

We are now ready to invest the case for casting; but, before going further, we must be sure that we are ready to proceed with the operation at once. The case must be heated up and cast as soon as invested; otherwise checks are sure to occur, and the cast will be spoiled.

Standard Investment Compound (not Imperial) is recommended for all casting operations (not for models). It is finely ground, yet porous, withstands the action of heat better than others and reproduces the finest lines with the utmost nicety.

When ready to invest, not before, mix a sufficient quantity of Standard Investment to a consistency that will just admit of its being poured from the bowl. Paint the model thoroughly with the mixed investment, using a fine brush, being careful to fill all undercuts. Fill the plate-flask three-quarters full of the investment, place the model therein, and gently press to place.

The model should come to within one-half inch of the bottom of flask.

The flanges allowed to project at the sides near the labial end of the model will prevent its going into the flask too far.

Be sure to get model as nearly into center of flask laterally as possible.

When thoroughly set and dry, which should be in 15 to 20 minutes, slightly concave the investment at the bottom or small end, of flask, place in absolutely *clean* boiling water and let it remain until the wax is softened; a little gentle pressure with an old rubber file or long instrument, on the sprue-block will cause it to float out. Remove case from water at once and break waay any frail pieces of investment so

that they may not drop into the sprue holes (openings formed by wax gates). The remaining wax can easily be washed out by holding the case slightly oblique and pouring a small stream of absolutely *clean* boiling water into upper gate. Any tin receptacle with a small hole punched through the bottom at one of its edges makes a good vessel for the purpose. Care must be taken to exclude all dirt from the mold.

To burn out the wax place point of knife under edge of sprue-block and carefully lift from place; then heat on bracket of adjustable stand very slowly at first, keeping the flame low until steam no longer rises from the case. Then increase the flame until it is giving all the heat possible, holding it there until the wax has entirely burned out and the case is heated as directed above.

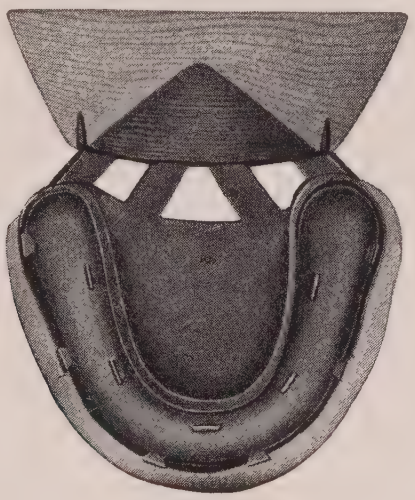


Plate 3—Model Mounted on Sprue-former, Showing Gates

If the boiling-out process is used, immediately after boiling place over a *slow* fire, allowing it to remain until all steaming has stopped, occasionally turning the flask. Test for moisture with mirror. When no moisture appears place directly over a *spreading* flame. Cover with an inverted pan to insure even distribution of heat, occasionally turning flask until it is a dull red all over and stays so. *Do not* permit flame to strike directly upon the investment at any time.

When the case has been carried to this point put an ingot of Aerdentalloy or *double refined* Aluminum in the melting crucible and set above flame with Economy Heat Cap over it. Now invert flask and let flame come in contact with crucible surface while metal is melting.

The overheating of the metal will ruin it, and the melting process must be carefully watched. A blowpipe flame should not be used directly on the metal.

When metal has fused (*fused*, remember, not burned), pump up the vacuum to twenty or twenty-five inches; take case from fire and place on bed-plate of appliance, first examining bottom of flask and bed-plate to see that there is nothing to prevent *perfect* contact. Turn valve to see if contact is perfect.

When contact is perfect, the hand of the indicator will fall very slowly; but if contact is not perfect the hand will fall rapidly.

Grasp the crucible, containing the molten metal, with a pair of Universal Laboratory Pliers and quickly pour the metal into the funnel-shaped depression in the top of flask (called crucible). When the metal is all in and the sprue holes covered turn the valve.

The pouring of the metal and opening of valve should be made almost one continuous movement as a very little delay at this point will spoil the case. Never turn the valve until all the metal is in the crucible, but do not delay. Prompt, decisive action is necessary.

The metal chills very rapidly, and both case and flask should be nearly the temperature of fused metal when pouring.

Remember, sharp holes in the plates indicate heating too fast and thereby exploding pieces off the investment on the inside.

Round holes indicate that the case was not hot enough before casting, or at the time the cast was made. Holes along edges indicate that too little metal has been used.

Let the case stand before opening until it has cooled enough to be picked up by the naked hand. Remove case from flask. Cut off sprues, preferably with saw. finish with files, stones, emery paper, felt cones and pumice, and polish with any good material. Clean and oil the flask on the bottom to prevent rusting while flask is not in use.

We do not recommend the casting of teeth direct to metal plates, although it can be done. The vulcanite attachment is preferred as safer and better.

Some Important Suggestions

Be sure to test the appliance for leakage before attempting to cast. To do this, pump up the gauge to fifteen or twenty inches; put flask or ring on bed-plate and firmly closing the larger opening with the palm of the hand, open the valve; the hand of the indicator will remain stationary, provided contact is perfect and there is no leak. Otherwise the hand will fall, rapidly or slowly, depending upon the nature of the leak. If there is a leak, find it and remedy it before going further.

If the flask has become oxidized on bottom and that is the point of leakage (which usually is the case) mix some *fine* carborundum powder with oil on a piece of *plate glass* (not ordinary glass because its flatness cannot be depended upon), and grind bottom surface of flask on glass until perfectly true and clean. Also oil contact surface of bed-plate.

Do not let your rings or bed-plate become rusty or dirty; oil them immediately after using and cover bed-plate when not in use. *Bear in mind* that neglect in keeping clean the bed-plate and neglecting to keep the rings flat on the bottom mean failure.

If the leakage is not found to be as indicated above, place a little saliva or soap suds around the different joints between tank and attachments and around air cocks; then pump up, place the palm of hand over bed-plate and turn the valve. The leakage will cause the saliva or suds to be drawn in. If the leak is at a joint, unscrew the attachment, mix a little dental cement and place it on both connections and screw up.

Should there be leakage of air about an air cock, remove the thumb control by taking out the screw on rear end and removing cap-washer, when a light tap will loosen it. Give all contact surfaces a light coating of special valve wax, supplied with the outfit. Additional quantity can be procured from the manufacturer (price, 10 cents per box).

Should it still be difficult to maintain a vacuum in the cylinder, the trouble may be caused by the collection of dust and wax about the pump valve. Remove pump and valve; clean all parts, valve, valve-seat and hexagon cone tip with gasoline and

replace. If this does not remedy the difficulty, procure a new valve from the manufacturer (price, 10 cents); remove the pump, take off the nut on its inner end, and the valve will be found in the nut. The nut is of soft metal and must be handled carefully. Use a true wrench, with sharp square jaws.

Replace the valve removed with the new one, being careful to insert so that the cork in the valve will impinge against the cone-point of the nut when air is exhausted from the Appliance. Smear a very little paint or white lead on the thread of the nut, and screw to place.

The pump plunger should be oiled occasionally through the holes through which the air escapes.

Slight leakage of air into the tank is liable to occur owing to the tremendous air pressure if an attempt is made to hold the vacuum too long. It is practically impossible to hold a vacuum for any great length of time. The vacuum should be produced, therefore, just previous to melting.

If the indicator of the gauge does not register correctly, remove the rim, the glass front and the face of the indicator. This allows free access to the simple inner mechanism of the gauge. In re-assembling, put indicator or hand of gauge over its pivot with the point just below the pin to the left. Press the indicator firmly to place, then spring the end over the pin and replace glass and rim. If necessary to remove the gauge, first take out the glass to prevent breakage; then place a light wooden strip across the face of the gauge, resting on the rim, and another across the back. These strips should project beyond the periphery of the gauge sufficiently to give leverage and act as a wrench. Then unscrew the gauge from its seat.

INLAY CASTING BY THE VACUUM PROCESS

By L. W. Strycker, New York

Prepare cavity so that wax will draw from it without dragging or becoming distorted. If properly prepared, the wax will draw out in one way only.

Freely moisten cavity, or use a very little alboline, to prevent wax model from adhering to walls. Be careful to get none of the lubricant on point of wax to which sprue is to be attached, nor upon the sprue wire.

Soften Standard Inlay Wax and force into cavity, being sure that it goes firmly to every portion; if on the occlusal obtain bite.

Chill wax in cavity, burnish to margins, carve to conform to occlusion, restore contour, allowing wax to extend slightly over margin of cavity, and remove model with a sharp instrument.

Select a sprue wire of a size adapted to size of model, being careful not to use one too large; a small one should be used for small models.

None but perfectly *clean* wax should be used and the wax pattern should be so carefully made and handled, and the surface so well polished, that it is without a flaw.

Inlays, either of gold or acolite, should be cast as soon as wax pattern is made, while the wax is still warm from the mouth.

Slightly heat point of sprue wire and attach it to wax model, adjusting wire in crucible-former so that the bottom of the model will be no nearer than one-eighth of an inch to the bottom of casting ring, when the top of sprue-former is even with the top of ring.

The investing material should be carefully chosen. It must conform to the pattern perfectly, so as to produce a perfect casting, exactly reproducing the original.

It should be an investment that will not crack or check, but will harden under heat, so that when the molten metal enters, it will not break down the frail walls of investment. An investment that above all expands under heat, taking up as much as possible the natural shrinkage of metal when cast.

Standard Investment Compound has been specially prepared for the vacuum process of casting. There are other good investments for other methods, but none is so good for the vacuum process.

Mix Standard Investment Compound with tepid water to consistency of thick cream and fill ring.

With a fine sable brush (the finer the better), carefully cover model and wire with the compound, working carefully into every angle and cranny and carefully blowing the investment off once or twice to prevent bubbles forming next to wax model; bubbles fill with metal when cast, causing rough casting; failure to avoid these bubbles, no matter how small, will prevent the fitting of the inlay. Paint on enough investment to cover the model thoroughly, and then place crucible-former with pattern attached on any flat surface, pattern upward; then set ring over this with *small end up.* Pour investment in from one side, until ring is filled. Then take firm hold of ring with one hand, being careful not to move it laterally, and slightly raise it, to allow the air bubbles to escape around the bottom of ring, but do not jar it by tapping on the side, because wax has an affinity for air bubbles

suspended in an investment and tapping will cause them to attach themselves to the wax pattern and will not release. For acolite, it has been found better to invest a little higher in ring than for gold. Fig. 1 illustrates a good investment position for acolite and Fig. 2 for gold.

Figure 1 also illustrates an incorrectly formed crucible. Flame from blowpipe cannot reach the metal and it will not fuse properly. The form should be shallow and wide as shown in Fig. 2. This allows the flame to envelop the metal and it will fuse properly.

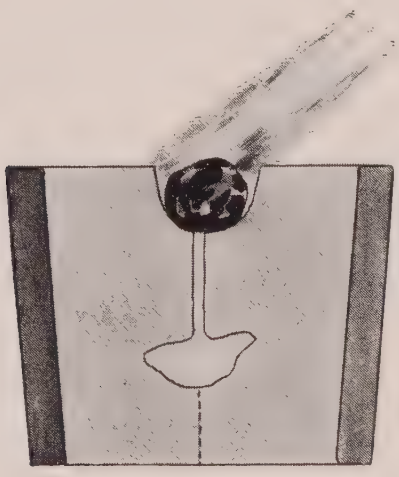


Fig. 1.

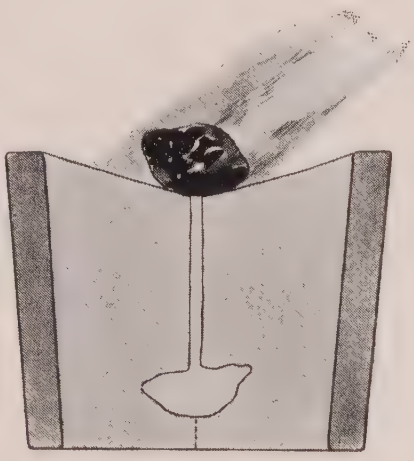


Fig. 2.

When investment is set (which, if properly mixed, takes about eight minutes in small ring and twelve minutes in large ring), concave the investment slightly at bottom or small end of ring. Avoid a smooth surface, as the air will not draw through a smooth surface as readily as a porous one, and be sure that the bottom of ring is *perfectly clean.*

With knife or small instrument gently lift out the crucible-former; the sprue wire will remain in the investment; heat the sprue wire sufficiently over a Bunsen Burner to remove it from investment. In removing sprue wire, hold ring upside down, thereby avoiding the danger of small particles of investment falling into sprue hole. (See Fig. 3.)

Fig. 3

Now oil the bottom, or small end, of ring only (with alboline), then ring is ready for heating. Place it, on its side, on the heating stand, over Bunsen Burner, so that heat from flame strikes about the center. *Heat very slowly* at first, as too rapid heating generates steam within the investment, causing it to explode and break away small particles of investment, thereby endangering the casting. As soon as heat is turned on ring, cover with heat cap and gradually increase heat, turning ring around from time to time, until it has become a dull red all over and the investment is also red hot through and through. This last may be determined by holding the ring with a pair of Universal Laboratory Pliers and looking down into the sprue hole, where it will be seen that it is a dull red at the bottom. Be sure the wax is thoroughly burned out; a frequent cause of failure lies here.

When case is about heated, pump up vacuum until the gauge registers fifteen inches. See that seat for ring is perfectly clean. When case is hot place ring in position on bed-plate, with *small end down.*

Before fusing the metal test the contact of ring to bed-plate, by turning valve on and off quickly. If the contact is perfect, the indicator will fall very slowly, if at all. When the contact is not perfect, it is usually made perfect by turning the ring on its base.

If scrap gold has been kept free from platinum, silver and base metals, it may be used for inlays. It has the advantage of retaining its shape better than pure gold. Before using, however, always melt scrap gold into a nugget, on a charcoal block. Never melt scraps on the investment as small particles may melt before the mass and drop into sprue entrance and clog it.

If scrap is used it should first be boiled in 50 per cent. Nitric Acid, to remove any base metals that may be present, washed and placed upon a charcoal block and melted. While the mass is in a molten condition it should be sprinkled with Ammonium Chloride (Sal Ammoniac). This should be repeated until the gold ripples like water. This may be remelted in a carbon crucible and cast into ingots for future use or used as it is.

Very little flux should be used in melting gold, as there is danger of its flowing into the sprue and closing the opening into the mold, preventing a perfect cast, even if the gold goes down at all. Borax should never be used for a flux. It has a tendency to seek the bottom of the molten metal and will cover up the sprue hole.

A nugget of sufficient size should be used not only to cast the inlay but the sprue also, and still have a sufficient quantity left in the crucible to keep air from entering the opening. Holes along the sprue indicate that too little metal has been used.

Fuse metal, if gold, reducing every particle to a thoroughly liquid state. Then turn the valve and *keep the flame on the gold* until the indicator shows a drop of five or six points. It is not sufficient merely to melt the gold. A *very* little Ideal Flux, sprinkled carefully on top of the melting mass, will facilitate melting and flowing. No flux need be used in melting 24-karat gold.

A good blowpipe is very essential, one that has perfect combustion. The quicker the gold is liquefied while the investment is hot, the better the results and the more perfect the reproduction of the wax model. A natural gas flame is generally not hot enough.

It is *extremely important* that gold be *thoroughly* fused and in perfect condition.

After the inlay is cast it should be washed thoroughly to remove all investment attached, then placed in Hydrofluoric Acid which will remove any fused silex. The sprue should then be carefully cut off and the cavity surface examined minutely for

any small bubbles of gold that may be attached. If the investment is painted on very carefully at first there will be little trouble in this respect.

If there is any difficulty in getting the inlay seated in the cavity, an excellent method is to heat the inlay slightly and apply a very slight layer of mercury to the surface. This will unite with the gold and upon evaporating away with increased heat the gold will be left with a frosted surface. If the inlay is now placed in the cavity any point that may rub against the walls will become burnished and can be cut away. When the inlay goes to place perfectly, the surface should again be etched, for the better adhesion of the cement.

All inaccessible surfaces of the inlay should be trimmed and polished before setting. However, if it is possible to reach the margin with a burnisher, it should be left slightly flush to permit a thorough burnishing before the cement sets, after which the margins should be finished and polished the same as for a gold filling.

To cast Acolite follow directions for casting gold, *except* that it must be borne in mind that Acolite fuses at a much lower point than gold, and is in the proper condition for casting the moment it becomes fluidic. Do not continue playing the flame upon the metal beyond that point. Heat continued beyond the fluid point will burn and oxydize the metal.

Acolite should be cast in molds at much lower temperature than gold. After the wax has been burned out, set the case off the fire and allow it to cool until it can be *comfortably handled with the naked hand.* Then cast.

Place the ring on bed-plate, drop the acolite into the formed crucible, apply just enough heat to fuse the metal, and open the valve. For casting acolite the vacuum should never be pumped up higher than 10 inches. Faulty margins are due to lack of pressure or loss of air.

Perfectly clean wax, water, gold and other materials *must* be used.

Investments *must* be properly mixed and applied.

The wax *must* be thoroughly burned out.

Aerdentalloy, Aluminum and Acolite *must not* be overheated.

A sprue wire adapted to the size of model *must* be used.

The investing material *must* be adapted to the vacuum process.

More metal than is required for the case *must* be used. If holes appear in casting near or alongside the sprue, more gold *must* be used; or add 2% platinum wire rolled thin, and fed into the boiling gold.

Good clean gold in nugget form *must* be used and thoroughly fused.

Cases *must* be promptly cast after the investment has set.

If inlays come out black and rough, case has not been sufficiently heated. Get it hot through and through, so that a dull red spot can be seen when looking into the sprue hole. Carbon deposit left by wax *must be burned out.* Dark spots are caused by gases given off by combustion of wax. If burned out clean before casting, the inlay will be clean.

REINFORCING PRINCIPLE OF MESH IN WAX PATTERN WORK

By A. W. Tatham, D.D.S., Detroit, Mich.

Detailed description of any particular form of crown is properly preceded by a few general considerations relative to this subject, so rapidly gaining in the attention of our profession generally. The principle of reinforcing wax patterns for castings is applied most practically to root bases for any form of crown, whether it is anterior all-porcelain with inlay setting or a posterior bicuspid or molar used either as a single restoration or abutment for bridge. Some forms of crowns lend themselves more easily than others to this method. Let us consider first the anterior inlay setting. A perfectly non-impinging coping is, beyond all dispute, the thing to be attained, and may be by the following technique:

Prepare the root end, making a well-defined bevel, and upon the root place a small strip of mesh—push pin through and trim to approximately the proper size of mesh to be used.

Now remove and run some hot wax upon the upper side of mesh, replace upon the root, and with a piece of soft red rubber such as is used for pencil eraser, force mesh and wax down upon the root. Special emphasis is laid here upon the use of the rubber, because nothing else will so easily and surely enable you to force the waxed mesh well home and slightly over the edges.

Take this pattern off, turning the inside upward, and you may find that a little more wax is required. If so, run in just a surface, or, with a hot round burnisher, remelt the whole inside. While this is warm, re-adapt thoroughly to the root, using rubber again. The slight margins may now be very easily and accurately brought to place by the use of a slightly warm flat burnisher. Trim this pattern, as you would a band, to suit the case in hand. Toward the labial side nearly all of the coping may be trimmed off for esthetic reasons. Replace the pattern as many times as is necessary to bring margins to place. To warm the pattern for these re adaptations, drop it into warm water, or move it to and fro over a flame until uniformly warmed through.

The next step is to place the crown upon the top of the root base pattern, and this is easily accomplished by warming the upper portion of the pattern while it is on the root, with a hot air chip blower. If wax is insufficient, run a little more over the surface. The tooth should be slightly warmed to prevent too sudden chilling of the wax. Thus it is readily seen a very thin wax impression, with a slightly

turnover edge for coping, may be manipulated with surprising ease and accuracy This coping will fit when cast and give uniform results.

The foregoing technique is employed where a pronounced band or margin is required. The following technique will be found very efficient where no extensive margin or turnover edge is essential.

Another technique especially useful for all anterior teeth where only a thin joint is required is to trim the mesh tooth-wise, press a piece of mesh with thumb upon the tooth, prick hole for head of pin, push pin with flange into tooth, having flange this side of mesh, tack with a little warm wax and trim the mesh around the crown properly.

The next step is to run enough hot wax around pin and pattern and you are ready to press crown and pattern upon the root.

In this technique the method is simple and positive, the mesh acting as a guide for extreme thinness of anterior part of pattern and prevents all spreading and splitting of pattern.

NOTE—Hollow sprues are very advantageous in root base patterns.

It must be quite apparent to anyone having made these patterns, without reinforcement, the number of difficulties encountered. One of the most annoying troubles in forcing down this pattern is the *splitting* or *spreading* of the wax—to say nothing of the lack of slight *turnover*, which is wholly absent or inaccurate. This, to my mind, is one of the most important uses of the mesh, as the forming of an accurate and esthetic adjustment of the anterior porcelain crown every operator is compelled to face. This operation is rendered practical and easy by the aid of the mesh.

CROWN BRIDGE ABUTMENT

Let us consider a type of crown for crown bridge abutment. The waxed mesh base is practically the same as for the base described above, except that the pin is bent over at a right angle or a thin disc of *gold* or silver tacked to *pin*, with solder mesh *always placed upper* side of *disc*, making removal of pattern easy—also that some roots require a definite band. Make this band by extending the waxed mesh

and trim as you would in forming a metal band. Note at this point a most important feature of gold mesh, i. e., it does not buckle; it is woven, therefore pliable, giving in all directions, and may be placed upon the root and extended some distance as a band without the annoyances encountered in continuous metal.

Select a tooth of the Goslee type, or Steele's Facing, all-porcelain type, since these give the V-shape slant or space necessary for adjustment and surface for soldering the dummy teeth in for bridgework. Here is a means for adjusting the tooth directly in the mouth in most cases without casting the root base separately—eliminating running of models, etc. The mesh is placed upon the tooth, hot wax

run upon the mesh; pressed to place quickly; taken off the tooth; re-trimmed and re-adapted in the same manner as a root base impression. These two patterns are now ready to be attached. The point is that the mesh upon the tooth, the tip end for attaching, may be heated and attached at any angle or removed as often as is necessary, and when finally articulated, the porcelain tooth, by reason of the mesh reinforcing pattern, may be easily taken from the pattern without distortion.

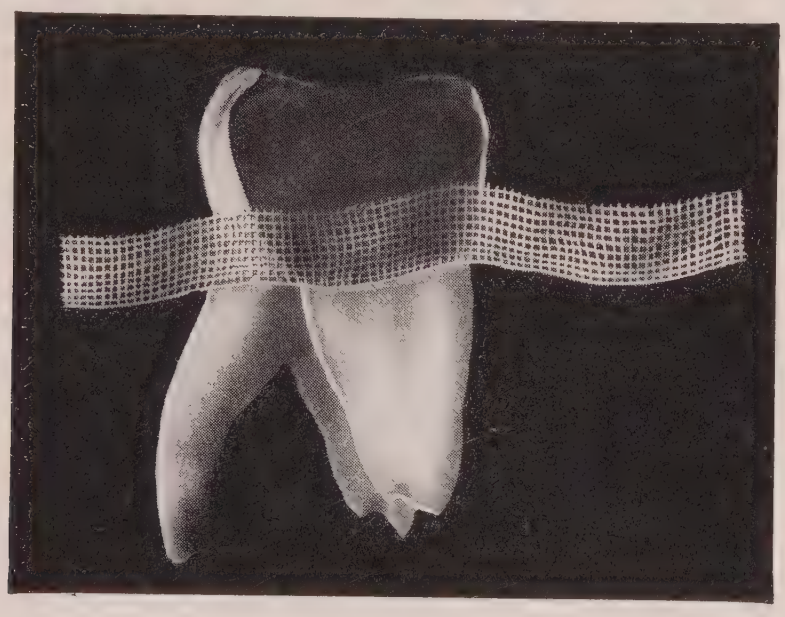
Furthermore, the mesh-wax patterns are unlike those with a continuous metal backing, because they can be re-shaped or changed readily. The enmeshing qualities, ever present in adjustment, render it possible to achieve through casting, truly splendid results. Only men who will not see or who prefer the old way, just because it is old, fail to see in this progressive method that which gives to casting its most desirable feature. The molar crown can be just as easily manipulated as a bicuspid. In the process of adjustment it may become necessary, in articulating a bicuspid,

to place a warm little ball of beeswax for a cushion while obtaining adjustment. This ball need not be taken out, but finished right over with the inlay wax. The beeswax cushion, remaining soft a long time, facilitates articulation, which otherwise would be difficult of accomplishment.

Should it become necessary to cast the base separately and then take an impression and run models, an accurate pattern for base and crown can be easily formed in a short time, and the two patterns can be cast in the same mold. The two castings may then be waxed in place upon the articulation and soldered together. Care must be taken to make the root base pattern very thin. There is to be noted here a very important point in favor of the mesh. A hot spatula may be run over, where pattern is in position on root, taking off the wax or shaping right down to the mesh

itself, and the impression on the under side will remain unharmed. This pattern is left very thin so that there will be room for adjusting the tooth coping to the root base coping when they are set upon the articulator for articulation. It is assumed that a tooth will be selected and approximately fitted before attempting to form any pattern.

Much might be said concerning the modifications of these two types, but believe that the anterior all-porcelain type for anterior and the saddle shape all-porcelain type for bridge abutments are the most generally used, being esthetic and economical. The selection of teeth for bridge abutments and dummies for bridgework would be seriously hampered for casting without a proper facing type of tooth suited to wax pattern work. The usual type of fixed pin facing tooth is not very satisfactory for casting. The new Dimelow facing presents a form of facing that is best suited to wax pattern work. The staple pins draw with the wax mesh pattern, giving a replaceable facing The staple pins enter into the holes of porcelain facing at an



angle, giving strength and permitting the tipping of the cutting edge of the facing. This facing has a distinct advantage in short bite and forming of wax mesh dummies.

It will be readily seen that the reinforcing principle may be applied to any form of root of any size, in any position, anterior or posterior—without having always to change technique or to encounter other difficulties.

ALLOYED EDGES

It is quite well established that pure gold, properly treated, casts best. For a thin margin or band, the one objection to pure gold is that, being soft, it lacks the proper tenacity for polishing and burnishing to advantage. The mesh is 22k, and when the pure gold is cast into it the edges or margins become an alloy, giving the pure gold just the required quality for this part of the casting. Thus, one may cast with pure gold and while in the mold form an alloy where it is most needed.

CERVICAL TWO-THIRDS

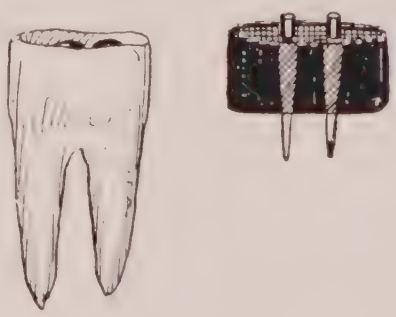
There are very few operators who are not willing to admit that the approximal space at this point offers some difficulties and inaccuracies in forming the wax pattern. The application of reinforcing the wax pattern at this point is so simple and effective that only a brief description of the technique is required. Manipulate

between teeth as you would a piece of silk tape; enter the mesh into the pattern with warm, thin spatula; remove, trim surplus mesh, leaving margin; over this flow a little wax; return to cavity and burnish margin with warm spatula. By this principle you are always certain that the cervical two-thirds is correct.

Just a word in regard to compound inlays or shallow wax inlay patterns. These patterns often become distorted in drawing, and is not noticed until too late. Many times the adding of wax to an edge or margin of these types of inlays is quite difficult. When the general reinforcement or framework of mesh is employed, these difficulties are obviated. Technique is similar to root base. Another feature of no minor

importance is the "Mesh Bite Crown." A band is made and adjusted in the usual way. Attach a mesh cover at top of the band. Tack mesh with solder at two points. A slight amount of wax is placed in the mesh and a bite is taken. Easy and accurate adjustment is quickly made, requiring no carving inside and taking a minimum amount of gold for occlusion. The crown is cast. The outer edges of the mesh prevent the edges of the occlusion from shrinking in over the band. Union is perfect.

In the case of the gold crown, where the bite is very short and the crown part of tooth is gone, generally requiring a solid construction, and where a porcelain crown cannot be used—make band in usual way; cap with mesh. Insert pins through mesh



into root channel. The bite is now taken and crown is ready for casting. This gives a strong attachment since the casting usually has at least two pins, and these may be tied together by placing a small amount of wax between the pins close up to the top on the under side. In the casting, gold takes the place of the wax and makes a very strong connection of the pins to the crown.

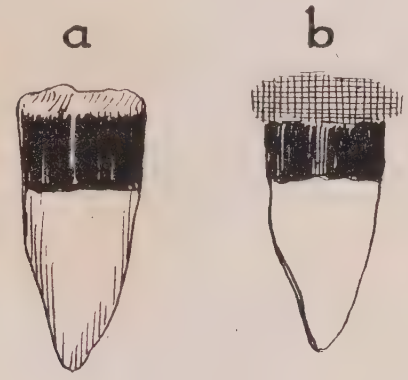
CONTROL OF SHRINKAGE AND WARPAGE

How, it is often asked, can the mesh exert any restraining power over the cooling metal? Let the most conservative but impartial operator make a reasonable number of tests, casting both with and without the mesh, taking the same care that he does in his ordinary practice in casting, and he will find results more uniform with

mesh than without. Without mesh, under ideal conditions, with a perfect technique, and the expenditure of much time, observing carefully all the details of casting, one can obtain good results. Now, the majority of busy practitioners who are doing casting, appreciate some of the difficulties, especially in root base work, when they get down to every-day practice and have an open mind and a welcome for a simple and scientific principle that lightens, expedites and assures good results.

Here is the result of a test made:

A wax pattern with several thicknesses of mesh, also one without mesh, were cast at the same time, under the same and very favorable conditions, and submitted for analysis to an expert. It was found that the specific gravity of the casting containing



the mesh was considerably less than that without mesh, indicating that the interstices contained air, and which would have a tendency to throw the contraction from the surface which the mesh immediately underlies. Another theory is that the casting cools quickest around the mesh, inasmuch as tests have proven that the mesh does not melt upon being surrounded by the molten gold, and which would have a tendency to minimize the contraction in the surface which the mesh immediately underlies—the adaptation surface.

Exhaustive tests have also proven that the mesh does not hamper the casting. Care, however, should be taken to bring the gold to liquid state. Use equivalent to ten pounds' pressure.

NOTE. A certain amount of change of shape of wax pattern is due to the wax. The mesh acts as a stiffener and prevents this trouble.

COMBINATION FILLINGS OF CAST GOLD AND PORCELAIN OR SILICATE CEMENTS

By Dr. C. H. Neill, Fairmont, W. Va.

This is a method of using cast gold inlays in conjunction with low-fusing porcelain and silicate cements.

In the large approximal incisor cavities in the anterior teeth, to replace the ordinary contoured filling or contoured inlay, I prepare the wax model in the usual manner and remove the labial aspect of it; prepare in the labial aspect a box-shaped cavity, cast inlay, cement into position, and start a new operation on the labial cavity prepared in the inlay. That gives us the same strength of a gold inlay without the labial aspect of gold. If artificial enamel is used the incisal edges can be well protected. If low-fusing porcelain is used as a veneer there need be no gold showing at all.

THE TECHNIQUE OF CASTING

USING STEELE'S INTERCHANGEABLE TEETH AND BACKINGS

By Dr. C. E. Talbert, Columbus, Ohio.

I shall not advance any theories or suppositions in the paper which follows, but will give merely a plain statement of facts which have been proven by several years of experiment and daily practice.

The technique of casting a crown or bridge, using Steele's interchangeable teeth and backings, is practically the same, up to the point of investing, as that of a crown or bridge that is to be completed by soldering, the only difference being that the backings and other parts to be cast upon must be *fluxed* in the manner as hereinafter described, and that the waxing must be more carefully done and the piece carved just as it is desired to have it when finished.

Let us take, for example, an incisor Richmond. You are supposed to have the coping and pin in place, either in the mouth or upon a model. It is imperative that

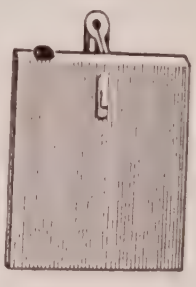


Fig. 1

the pin be either of platinum or iridio-platinum, as a base metal, such as platinoid, will often become disintegrated and weakened. Select the proper tooth and grind to place, preserving the bevel of the ridge-lap, or increasing it a little if necessary, so that when the grinding is completed it will touch the coping at its extreme labio-cervical point only, leaving a V-shaped space between the two. Now place the tooth upon the backing and trim the latter to the tooth, closely on the sides, but leaving it a little longer than the tooth at the incisal edge. Next grind the ridge-lap end of the backing to the tooth, giving it the same bevel. Remove the backing and, grasping it with a pair of soldering pliers, hold it so that the beveled end will be level, and place a tiny speck of 20k solder on the corner of the backing farthest from you, as in Fig. 1. Hold in the flame until the solder sweats down, but remove before it flows. Next take a piece of 34-gauge pure gold or a piece of platinum foil slightly wider than the backing and long enough to balance on the end thereof, with enough material projecting over the ridge-lap to cover the end of the tooth when the latter is in place (Fig. 2). Have this piece perfectly flat so that when it is laid upon the end of the backing it will have a three-point contact, viz: the little globule of solder, the opposite corner of the backing, and the end of the post. Carry carefully to the flame and hold steadily until a slight movement of the piece indicates that the solder has flowed and the piece settled to place. Now put the tooth on the backing and be sure that it goes easily to place without forcing, not only at this time but after all subsequent operations of soldering or casting. If there is found to be any obstruction, remove it carefully before proceeding further. Now trim around the cervical

edge, but leave that portion of the flap that overlaps the backing, which is to be burnished down closely, as is also that part which covers the end of the tooth (Fig. 3). Drop the piece, while hot, in pickle and leave for a few minutes. It will then be ready for the flux. The flux to be used—and it is the only one that can be used successfully—is a saturated solution of boracic acid in grain alcohol. This is also a most satisfactory flux for all small soldering operations.

To prepare a stock solution, fill a bottle about one-fourth full of boracic acid and fill up with alcohol, shake a few minutes and allow to settle, using only the clear

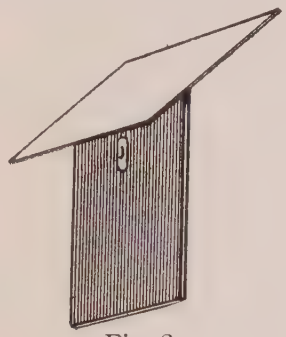


Fig. 2

liquid. If you have a considerable excess of the powder, the stock can be kept up by occasionally refilling with alcohol. The best way to apply the flux is from an office preparation bottle with a small camel's hair brush, or the piece can be dipped bodily into it.

Take the piece to be fluxed in a pair of soldering pliers and apply the solution. Ignite the alcohol from the flame and allow it to burn off. Then hold the piece in the flame a moment—until you see the deposit fuse, but do not allow it to approach a red heat. Allow it to cool spontaneously and you will find the surface uniformly covered with a thin film of flux that can be handled without displacement and which,

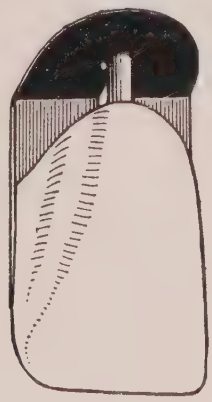


Fig. 3

in the subsequent operation of casting, will absolutely prevent oxidization of the surface to be cast upon. No care need be taken to keep the flux from the face of the backing, nor is any antiflux or other stop-out necessary, as in the case of a soldered piece, as the investment used, if properly applied, answers every purpose.

We are now ready to proceed with waxing up the case. Unlike the casting of inlays, the wax to be used is of little importance except as regards its tenacity in holding the parts together and the facility with which it may be carved. A good, sticky-wax is best to unite the parts so that they may be removed from the mouth or the model. The operation may then be completed with pink baseplate wax, which carves very nicely, or with any of the casting waxes on the market. Flow on enough

wax to give the desired contour and build the incisal edge to a thickness about equal to No. 20-gauge plate. Trim the wax flush with the end of the backing, which, as previously mentioned, must be slightly longer than the tooth. This is with the object of protecting the porcelain when the piece has been finished and finally mounted, which object may be still farther advanced by grinding the porcelain very thin, thus precluding the possibility of contact with the occluding tooth. After grinding, the porcelain may be repolished with gloss sticks or other polishing material.

Of course, the entire Richmond or bridge dummy, including the backing and post, may be cast in one piece if desired, in which case the method of procedure would be first to grind the tooth into place, either in the mouth or on the model, and then remove and either thoroughly wet or oil the slot and back of the tooth. Then flow on, to the proper thickness, some good casting wax, being sure to have the slot well filled. After chilling it may be waxed to place, carved as desired, the tooth removed and the case proceeded with as hereafter described. There are some serious objections to this method, however, the chief of which are, first, the difficulty of removing and replacing the tooth without distorting the post or backing, and the fact that after casting the post will fit the slot so closely as to preclude proper cementation when the case is completed. Furthermore, no matter how carefully the piece may be invested, there is almost certain to be some minute globules of gold cast along the post or upon the ridge-lap or backing, which would cause considerable trouble in removing.

Some of these objections may be removed by using the posts for casting which are supplied by the manufacturers, but the danger still remains that the post may be gotten out of alignment or otherwise displaced or the backing distorted. In view of these considerations, I strongly recommend the use of the backings, as supplied by the makers, in the manner already described.

The investment of the piece is next in order, and the *investment material*, next to the *flux*, is of the utmost importance. I shall not enter upon a discussion of the qualities necessary to a good investment, but will give you the formula for, and the method of preparing, that which I have selected as the best, after several years' trial of most of those now offered by the dealers. It is composed of four parts by weight of finely powdered silex and one part of French's *impression* plaster. These ingredients must be thoroughly mixed by repeated siftings. I sift them twenty to thirty times through a fine sieve and make up enough at one time to last several months, as the longer the mixture is kept the better it is, provided it is stored in a dry, warm place in *wooden boxes*, the wood tending to absorb any slight moisture it may contain. Too much importance cannot be attached to the mixing and curing of this investment material.

The operation of investing the piece is practically the same as that of investing an inlay. Place the sprue wire so that it points directly into the V-shaped space between the ridge-lap apron and the coping, and mount the piece on the crucible-former. Mix a tolerably thick batter of investment and paint it onto the piece with a very small stiff brush, working it well under the backing post and very carefully excluding even the minutest air bubbles. After the piece is well covered, place the casting ring on the base and proceed to pour the balance of the mix, being careful to add but little at a time, and working it down around the sides of the flask with a small cement spatula, and by holding the flask firmly down and tapping the sides with the spatula handle.

The correct proportions of investment material and water for a proper mix, as

well as a sufficient amount to fill the ordinary inlay flask, are 12 dwts. of investment and two teaspoonfuls of water. You double this quantity for a larger flask. Procure a small tin ointment box, and after weighing this amount shake it well down level and trim the box to the level of the material; you will then have a correct measure for all subsequent mixes.

When the investment is set, which will be in about eight minutes, warm and remove the crucible-former. Grasp the sprue wire with a pair of hot pliers, holding it so for a few minutes that the heat may be transmitted to the wire, when it may be easily withdrawn. Place the flask on its side on an inclined rack, about two inches above the opening of a Bunsen burner, with the sprue opening at the lowest point—that the melting wax may to a certain extent drain out. Have the flame turned as low as possible. It should not be more than half an inch high, as shown in Fig. 4. Keep at this point for twenty-five minutes, at the end of which time turn it up to

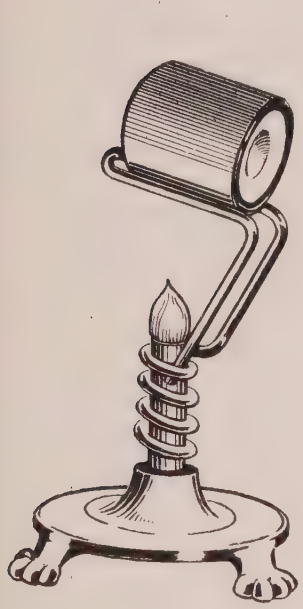


Fig. 4

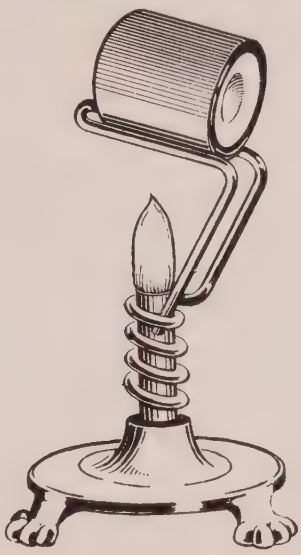


Fig. 5

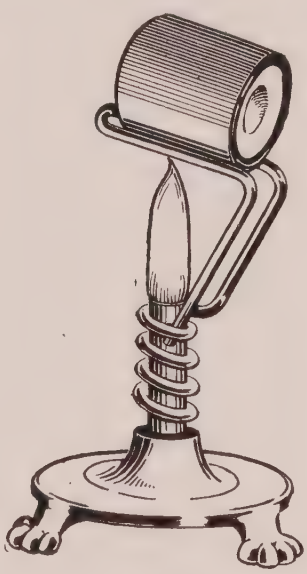


Fig. 6

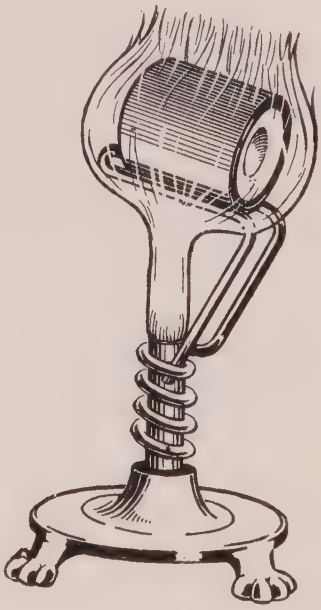


Fig. 7

about an inch (Fig. 5). At the end of five minutes more turn up until the flame barely touches the flask (Fig. 6), and after another five minutes turn on the full flame (Fig. 7). After five minutes more it is ready for the cast. To summarize: Twenty-five minutes for the first heat, five minutes for the second, five minutes for the third, and five minutes for the fourth—forty minutes all told. Have the air and gas so regulated in the burner that it will burn with a slightly yellow flame rather than a noisy blue one. The flame during the last heat will then lap entirely around the flask instead of splitting off at the sides. At the end of the time allotted for the heating the flask should show slightly red, but the investment not at all, and it must be removed from the fire and the cast made without allowing it to cool longer than is necessary while preparing to melt the gold.

The gold to be used in casting must necessarily be of considerable lower karat than that which it is to be cast upon. It has generally been conceded that the solder sold for use with 18k plate is good enough for a soldered bridge. At any rate, it is the highest karat that can be safely used in casting upon 20k gold or platinum alloy backings. If you wish to use a finer gold you must have pure gold or pure platinum backings. Before fusing the solder for making the cast it must first be melted into a nugget upon a charcoal block, using plenty of borax and applying only just sufficient

heat to accomplish the purpose. Do not attempt to use less than four dwts. of solder for casting a Richmond, and more in the same proportion for a bridge, as it is important to have plenty of excess. Note carefully the sluggish action of the solder under the blow-pipe so that you may be able to judge when fusing for the cast just when the fusion is complete, as it will not dance and boil as a higher grade of gold usually does. Also after casting, the pressure must be sustained a little longer than is necessary when using a higher grade of gold.

The technique of casting a bridge does not differ materially from that of a crown, except that provision must be made for easily removing it from the model and a greater number of feeders supplied.

Before pouring the impression any shell crown must be partly filled with wax and the posts of Richmond crowns partly covered so that by slightly warming they may be readily removed and replaced after cleaning. The model must then be slightly oiled between the abutments with liquid vaseline or other oil, and the case proceeded with as in case of a soldered bridge. This, however, is one of the methods often used in soldered work.

After the case is waxed and carved as it is desired to have it reproduced, there is nothing more to do but to fix the sprues and proceed to invest the cast.

The feeders must be at least three in number—one wire placed about the center and two feeders formed by little rolls of wax, one at either end of the bridge converging to the free end of the wire and waxed to it with a hot spatula. It may now be mounted upon the base or crucible-former and proceeded with as previously described.

In conclusion, I will recapitulate the more important considerations:

First—The method of fluxing, which has not to my knowledge been published before, is *absolutely essential* to a perfect union between the metal cast and the metal cast upon and will invariably produce that result.

Second—The investment must be one that will not shrink or check and one that will spread with a brush like paint and fill in smoothly without bubbles.

Third—The case must not be overheated—the merest approach to redness of the flask is permissible, but the gold within must *not* reach the red heat. This result will be closely approximated by following the formula for heating as given, but by experiment may be changed to suit any slight difference in the burner used.

Fourth—If solder is used in casting much caution must be used not to overheat in fusing, but be sure it *is* fused and cast as soon as you are certain that it is.

If these four essential features are carefully observed there will be few, if any, failures.

HOLDING INLAYS WHILE POLISHING

By Dr. G. B. Speer, Los Angeles, Cal.

In the February number of the SUMMARY, Dr. R. C. Brophy, of Chicago, gave a description of Dr. Moore's vise for holding inlays while polishing. My way is as follows:

Take a pair of Dr. W. Van Hook's (or other make) mouse tooth hemostatic forceps, which can be gotten at any surgical supply house for $1.25. Snap them on the inlay and you can hold it in any shape desired. Also, let your assistant turn a stream of cold air on the inlay while grinding and it remains cool. The assistant and cold air have been a great help to me at the chair by keeping the bur cool while cleaning out cavities.

And while you are buying your hemostatic, also buy a five-pound can of surgeon's green soap and use same for moistening felt and brush wheels in polishing plates. The remainder may be used for washing the hands. Once you have used this soap you will never go back to any other. It is not only cheaper, but cleanses and softens the hands much better.

How I make a sprue wire for holding and removing inlays: Take a German silver wire and flatten the end with a hammer; now trim off the edges until the flat part is only as wide as the thickness of the wire; now hold the wire in your pin vise, catching close to the flat part, and with a pair of pliers twist the flat part to form a screw, point the end with a file and you have a sprue wire that will hold.

Do not warm the wire, but insert by a pushing twist, thus screwing the sprue into the impression. Blow a stream of cold air on the impression and your wire will hold.

CAST BACKINGS AND CROWNS FOR STEELE'S FACINGS

By James B. Doyle, D.D.S., Grand Rapids, Mich.

First take the Steele facing, then a piece of platinum or pure gold, about 36-gauge. Pinch it together and insert it in the groove, then take a small instrument and burnish it to place so that it fits the groove perfectly, then take a piece of 22k plate gold or platinum and cut it so it will readily pass into the root canal and the groove of the facing. Remove and solder these two pieces together; after greasing your facing with vaseline you are ready for your inlay wax. Mold it as well as possible to the back of the facing and your root canal pin. Then after the wax is properly warm you insert it in the root canal and press up firmly. Remove and carve until you have the shape desired. Then remove your facing and you are ready for casting. Now you have a perfect fit of your facing to your backing and a perfect fit to your canal.

I cast all my backings for Steele's facings. You proceed in the same manner except that you do not use a pin. There is a great advantage in making bridges with Steele's facings and casting your backings. The reason so many facings break is because you cannot get uniform thickness with solder. You will get a little more solder in one place than another and it is liable to spring. That spring will be just enough to crack your facing. And another thing, you cannot always get your backings to fit so that the stress of mastication will come upon it. By casting your backings you overcome these difficulties.

CAST CUSP CROWN

By C. E. White, Indianapolis, Ind.

Prepare root in proper manner, cut a piece of 22k gold large enough to make the band, wide enough to include cusps, fit the band to root and trim to occlusion. Contour the band with pliers to form the cusps. Place warm inlay wax, or better still, Alexander's gold, inside the band, condense same or trim and carve (if wax) to occlusion. If wax, invest and cast; if Alexander's gold, place solder on cusp of crown, place over Bunsen burner, burn out wax and sweat solder in the gold. Polish the crown and cement it on at the same sitting.

AN INLAY FOR COMPOUND CAVITY INVOLVING INCISAL WITHOUT STEP

By H. C. Dean, D.D.S., Columbus, Ohio.

It is often desired to place a gold inlay involving the approximal side and incisal edge, without sacrificing the sound structure of the tooth to make a step. This may be done by placing an iridio-platinum post near the incisal after the inlay has been completed. Inlay should have a wide, deep groove carved in the approximal surface extending from near the incisal to the gingival. This should be done in the wax model. This groove is to pass over the iridio-platinum post, when the inlay may be set from the incisal without interference from an approximating tooth. There may be an extension of this iridio-platinum post for additional retention in the groove of the inlay. Since the inlay model is completed before the incisal retention post is provided, there is absolutely no interference with the removal of the model. The retention post fits loosely in the tooth and in the inlay until cemented. Post and inlay are both set with same mix of cement.

HOW TO CAST AN INLAY WHEN YOUR CASTING MACHINE IS OUT OF ORDER

By Dr. W. J. Boydston, Fairmont, W. Va.

The casting machine consists of a tube about eight inches long and about an inch and a half in diameter, filled with plaster of Paris to within about two inches of the top. Fill this vacancy with putty or moldine. Over this place wet tissue paper, about six to eight thicknesses. Heat your investment and proceed as in other casting, exerting about six to eight pounds of hand pressure.

Then this other crown is a porcelain-faced cap crown, by use of Steele facing with cast back. You grind your tooth the same as for a gold crown; then grind buccal surface the same as for Richmond crown. Then cut face of band out; swage your cusp and catch it on the lingual edge of band with solder; readjust to tooth; allow patient to bite and adjust articulation. Then grind Steele facing to approximately fit portion of band ground away; cut back the facing with vaseline; press it into warm casting wax and while still warm place on face of band. Press into place, chill, remove, trim, and build up contour with wax. Remove facing, insert screw in the buccal incisor edge of wax; invest, and proceed as in other casting. After casting flow solder around cast and band. Grind down and finish and place in facing.

TABLE OF CONTENTS

THE CAST INLAY:

Early Attempts at Inlay Casting ..... C. V. Vignes 12
Technic of a Cast Gold Inlay ..... A. F. Miller 13
Cavity Preparation for Cast Gold Inlay ..... Thomas P. Hinman. 37
Shaping Wax Model for Gold Inlays ..... C. E. Abbott 38
The Cement Line in Inlays ..... Clarence J. Grieves. 39
Some Practical Points on Inlays ..... L. E Custer 68
Separate Base for Gold Inlay ..... F. R. Henshaw 67
The Cast Gold Inlay ..... James W. Lyons ... 81
Anchor for Fillings and Inlays ..... W. H. Pelton 105
Method of Producing Perfect Margins ..... C. Kabell 116
Nuggets of Gold—Inlays ..... O. E. Lanphear 117
Limitations and Uses of the Gold Inlay ..... H. M. Semans 120
The Gold Inlay ..... J. V. Conzett 122
Hollow Cast Inlays ..... W. S. Payson 125
To Hollow Out Wax Model for Inlay ..... S. T. Neill 125
Casting Wax ..... T. C. Trigger 136
The Impression Method for Inlay Work ..... Henry W. Gillett ... 137
The Cast Gold Inlay ..... C. G. Myers 149
Porcelain and Gold Inlays ..... A. W. Starbuck 163
Amalgam Base for Gold Inlay ..... Steele F. Gilmore ... 192
The Working Model for Inlay Practice ..... H. W. Arthur 205
Conductivity of Cast Inlays ..... S. H. Guilford 208
Some More Progression ..... R. C. Brophy 213
Inlay Casting by the Vacuum Process ..... L. W. Strycker ... 230
Holding Inlays While Polishing ..... G. B. Speer 245
Combination Fillings of Cast Gold and Porcelain on Silicate Cement ..... C. H. Neill 239
Inlay for Compound Cavity ..... H. C. Dean 246
How to Cast an Inlay When Casting Machine is Out of Order ..... W. J. Boydston 246

CROWN AND BRIDGE WORK:

Porcelain Crown with Cast Gold Base ..... W. A. Sanderson ... 14
Telescopic Crown for Bridge Work ..... E. L. Kanaga 22
Casting Process as Applied to Crown and Bridge Work. Hart J. Goslee 28
Restoring Teeth for Crown and Bridge Work ..... C. Jensen 67
Hollow Wax Dummies of Bicuspids and Molars ..... T. C. Hutchinson... 69
Cast Gold Crown ..... C. E. Meerhoff 80
Cast Jointed Logan Crown ..... C. J. Burris 80
Casting Pins for Crowns ..... W. A. Stewart 102
Casting Backings for All-Porcelain Fronts ..... D. Haight 102
Anterior Bridge Abutments for Splinting ..... George C. McCann. 104
Cast Posts for Steele's Facings ..... George H. Walker.. 106
Methods of Casting in Crown and Bridge Work ..... W. G. Crandall 107
An Ideal Bicuspid or Molar Crown ..... George S. Schlegel.. 111
Cast Abutments for Bridges ..... W. W. McCall 112
Pin and Coping for Porcelain Crown ..... Paul J. Boyens 115

TABLE OF CONTENTS—Continued

Crown and Bridge Work ..... J. H. Laudry 123
An Anterior Cast Bridge ..... E. Cunningham 125
Casting Large Bridges ..... W. H. Hayden 126
A Richmond Crown Without Solder ..... T. C. Hutchinson... 127
To Overcome Weakness of Cast Gold Bridge ..... W. J. Montgomery. 136
A Combination Cast Crown ..... O. H. Simpson 155
Restoration by All-Porcelain Bridge and Bridges upon Cast Bases ..... J. M. Thompson... 157
Subgingival and Canal Restoration in Crown Work.. Edward C. Mills... 161
Casting on Porcelain ..... W. C. Gillespie..... 217
Cast Backings and Crowns for Steele's Facings ..... James B. Bayle.....245
Reinforcing Principle of Mesh in Wax Pattern Work.. A. W. Gatham.....234
The Technique of Casting ..... C. E. Talbert.....240
Cast Cusp Crown ..... C. E. White.....246

Root Restorations:

Restoring Bicuspid Roots ..... Auber Peebles..... 18
Restoration of Fractured Root ..... J. Maurice Crosby.. 64
Restoration of Broken-Down Roots with Acolite ..... James B. Lester.... 103
Restoration of Roots of Bicuspids and Molars ..... A. W. McCullough.. 160

Cast Metal Plates:

Preparing Inlay Wax for Base Plate ..... Newton W. Hiatt... 68
The Cast Aluminum Plate ..... Robert Seymour.... 133
Collodion as a Separating Medium ..... B. L. Worthley..... 136
Cowbell Method of Casting Plates ..... D. D. Campbell.... 197
Cast Aluminum Plates ..... George H. Wilson... 200
To Obtain a Smooth, Dense Surface on Casts ..... F. L. Olds..... 215
Plate Casting by the Vacuum Process ..... W. L. Harpel and F. L. Olds..... 225

Origin and Progress of Dental Casting:

Ancient Origin of Dental Casting ..... L. W. Stryeker..... 5
Experience and Experiments in Casting ..... J. R. Osborne..... 65
Latest Developments in the Cast Gold Process ..... Albert L. LeGro.... 71
Casting; A Retrospect ..... J. G. Lane..... 91
The Scope of Casting in Dentistry ..... R. C. Brophy..... 113

Gleanings from the Field of Experience:

Investing to Avoid Shrinkage and Distortion ..... C. J. Clark..... 15
Expansion and Contraction of Gold in Casting ..... C. J. Clark..... 19
Air Vents in Casting ..... D. D. Smith..... 68
A Soldering Device ..... T. B. MaGill..... 90
Casting Gold on Porcelain ..... E. Cunningham.... 122
The Cast Clasp ..... W. B. Caldwell..116–132
Places Where the Casting Process Has Been Found Useful ..... E. T. Tinker..... 193
Cast Gold Splints for Pyorrhea ..... J. G. Lane..... 196
Some Phases of the Casting Process ..... C. S. Van Horn.... 202
Reproduction of Flowers, Etc., by Casting ..... T. C. Hutchinson... 210
Remarks on Casting ..... Robert N. LeCron.. 221

ANOTHER VALUABLE BOOK

Interstitial Gingivitis
and
Pyorrhœa Alveolaris

By EUGENE S. TALBOT, M. S., D. D. S., M. D., LL. D.

Late Professor of Stomatology, Woman's Medical School, Northwestern University; Late Lecturer on Stomatology, Rush Medical College, University of Chicago; Fellow of The Chicago Academy of Medicine; Fellowship Member of the New York State Dental Society, 1908; Secretary of Section on Stomatology of the American Medical Association; Vice-President American Medical Association, 1905; Member VII International Medical Congress, 1881, London; Honorary President X International Medical Congress, 1890, Berlin; Honorary President XII International Medical Congress, 1897, Moscow; Corresponding Member Budapest Royal Society of Physicians; Honorary President International Association of Stomatology, 1907, Paris; Member First French Congress of Stomatology, 1907, Paris; Honorary Secretary Pan-American Medical Congress, 1901, Havana; Honorary Member Odontologischen Gesellschaft, Berlin; Honorary Member Association Generale des Dentistes de France, Paris; Honorary Member Sociedad Odontological Espanola, Madrid; Corresponding Member Dansk-Tandlaegeforening, 1901; Honorary Member Stomatology Society of Hungary; Corresponding Member of the Italian Stomatological Federation, 1910; Member Chicago Academy of Sciences; Member American Association for the Advancement of Science; Charter Member American Institute of Criminal Law and Criminology; Member of the Authors' Club, London. Author of the following books: "The Irregularities of the Teeth and Their Treatment;" "Chart of Typical Forms of Constitutional Irregularities of the Teeth;" "The Etiology of Osseous Deformities of the Head, Face, Jaws and Teeth;" "Degeneracy: Its Signs, Causes and Results;" "Developmental Pathology: A Study in Degenerative Evolution," Etc., Etc.

PARTIAL CONTENTS

Transitory Structures:: The Jaws and Alveolar Process; The Alveolar Process Under the Microscope; The Gums, Periosteum, Mucous and Peridental Membranes Under the Microscope; Inorganic Salts and Interstitial Gingivitis; Theories of Interstitial Gingivitis; Degenerate Acid and Interstitial Gingivitis; Heredity and Environment in Interstitial Gingivitis; Degenerate Tissues in Interstitial Gingivitis; Bacteriologic Researches in Interstitial Gingivitis; Interstitial Gingivitis; Researches on Animals in Interstitial Gingivitis; Researches on Human in Interstitial Gingivitis; Researches on Human in Pericementis; Local Causes of Interstitial Gingivitis; Constitutional Causes of Interstitial Gingivitis; Climate Influences in Interstitial Gingivitis; Scurvy in Interstitial Gingivitis; Toxins Producing Trophic Changes; Autointoxication in Interstitial Gingivitis; Urinary Signs of Autointoxication; Arteriosclerosis, Endareritis Obliterans and Nerve End Degeneration; Absorption of the Alveolar Process and Calcic Deposits upon the Roots of the Teeth; Pyorrhea Alveolaris; Constitutional Effects of Pyorrhea Alveolaris; Treatment.

See reviews and opinions of this book on next page.

335 Pages : CLOTH $4.40 : 102 Illustrations

Published by The Ransom & Randolph Co., Toledo, Ohio

Dr. James Truman, in an exhaustive review of more than six pages, in *The Dental Brief* for July, 1913, says:

A new work from the pen of Dr. Talbot is an event not to be passed as a mere trifle on the great ocean of professional literature, but as a pronounced advance in scientific knowledge. It seems only yesterday that a work from this indefatigable investigator and writer was published, that the present writer regarded then as the author's masterpiece, but before the ink is scarcely dry in this comes this volume on interstitial gingivitis, the last, it is presumed, that will appear in book form from the author's pen.

Dr. Talbot's work is always, to the inquiring student, a mine of facts. He does not deal in theories, and the worker in his mine must be prepared with pick and shovel to delve with him deeply in the strata of undiscovered things.

This work is beyond question the only thorough exposition of this pathological condition familiar to the reviewer, either in Europe or America.

That there is no specific germ capable of producing this disease is abundantly shown, as the work proceeds, and the researches of Galippe have not been confirmed, either by the author or those associated with him. Dr. Theodore Chapin Beebe* in a valuable article on" Pyorrhea Alveolaris and Treatment by the Opsonic Method," says our vaccines are standardized at staphylococci ½ c.c. equalling 500 million, pneumococci ½ c.c. equalling 100 million. These are mentioned as being the two most common bacteria found in inflammatory conditions of the gums.

Chapter IX is taken up with the question of uric acid, which so largely dominated the dental profession at one period, especially by Peirce, Rhein and others. The judgment of the former was based on several experiments conducted at the Drexel Institute, Philadelphia. The author claims that these were too limited in number to be regarded as conclusive. He, the author, had had altogether "nine hundred and fifty cases, and only a fourth per cent. showed uric acid * * *. It It is safe to say that six per cent. was the actual per cent. of uric acid."

In the chapter on "Heredity and Environment," the author sums up his conclusions in a few words, "Interstitial gingivitis and pyorrhea alveolaris are not inherited."

Chapter XVII is one every dentist should carefully study. It is devoted to "Local Causes of Interstitial Gingivitis." If there was nothing more than this sentence in it, it should cause the average operator to think before deciding to operate on a patient. "In a word, whatever irritates the gum margin, peridental membrane, or alveolar process, is likely to produce inflammation which later becomes chronic." Nothing more suggestive could be framed in words. The author might have extended this chapter in the direction of warnings, and while he covers much, there is still more to be written on errors in crownwork, bridgework, etc.

In the chapter on "Absorption of the Alveolar Process and Calcic Deposits," the author states that interstitial gingivitis extends to the alveolar process through the periosteum as well as through the peridental membrane, and not (as dentists usually believe) by way of the peridental membrane alone.

The reviewer rises from the reading of this book of Dr. Talbot with a high appreciation of its contents. He feels assured that any one essaying to treat interstitial gingivitis, or pyorrhea alveolaris, will be better able to effect results, let his method be what it may, or however skilled he may be through experience. No other work with which the writer is acquainted can compare with this in a clear elucidation of the various phases of this important oral pathological condition. It covers all possibilities, but it will demand serious study. To buy this book and place it on the library shelf for occasional reference will not answer the author's purpose, nor does it appeal to the present writer. The work deals with a scientific problem, and problems of this nature require mental devotion of no ordinary character for their solution. The ideas sought to be taught must be made the operator's own. He must learn to think in the language of the science taught, and then diagnoses become a part of his secondary nature. In the final analysis the writer holds that the pathological conditions of the oral cavity and its relations to the general system will and must be conquered by stomatologists, and this accomplished, the health of the world will be placed on a much higher plane than has ever previously been known.

JAMES TRUMAN.

**Dental Cosmos* for May, 1913.

From *The Dental Digest*, August, 1913:

In this new work from the pen of Dr. Talbot we have the sum and substance of an experience covering thirty-five years spent in honest, intelligent and conscientious research study on the subject of the etiology, pathology and treatment of peridontal disease. The etiological experiments and treatment are made from the viewpoint that disease of the gums and the alveolar process are of an infectious nature; but as many different tissues and organs of the body undergo physiological and chemical changes, often due to inflammation from irritating causes, the author has endeavored to separate or classify those inflammations due to infections, and those due to chemical and local changes and constitutional irritations.

Dr. Talbot, in his introduction to this most valuable book, says: "The attempt has been made in the present work to reduce to order the chaotic notions as to etiology, pathology and treatment which, during the present century, have gathered around the morbid conditions erroneously entitled Pyorrhea Alveolaris. While even erroneous titles may have their meaning so fixed by usage that any danger from the error involved in the title may be practically nil, still this is not the case with the title just cited. It suggests erroneous etiology, since pyorrhea implies that there must always be a flow of pus, and hence that the disease must always result from infection with pus microbes. It implies erroneous pathology and erroneous treatment for the same reason. This being the case, such a title is so dangerously misleading as to compel in the present stage of dental science its modified use as a term for disease. With a view of clearing up this question at the outset by the use of a proper title, I have adopted as a designation for the condition hitherto known as pyorrhea alveolaris the term 'Interstitial Gingivitis'."

He considers the term interstitial is used by some pathologists in a .limited, obscure sense, but by the mass of dental pathologists, surgeons, physicians, and by medical lexicographers, the term is employed in precisely the sense in which it is used in the present work, and he quotes in support of his assertion the English surgeon and lexicographer, Quain, and Foster's "Encyclopaedic Medical Dictionary" (American).

One should closely read the introduction and thoroughly digest it, for it most fully describes the work which the author so ably presents to his brothers of the dental profession.

A glance at the chapter heads will give the reader some idea of the scope of the book:

Chapter V is of especial interest; it is confined principally to the histological appearance of The Alveolar Process Under the Microscope. Chapter VIII deals with Theories of Interstitial Gingivitis. Perhaps the most interesting chapter is XII—Bacteriologic Researches in Interstitial Gingivitis. A number of extremely interesting experiments are reported, and from these reported experiments Dr. Talbot forms the conclusion that "outside of a few specific diseases of the gums and alveolar process, some of which have been enumerated, no one has demonstrated that specific pathogenic bacterial infection is a cause of interstitial gingivitis, although the mouth is known to be the breeding ground of an extensive variety of germs."

Chapter XVII is devoted to "Local Causes of Interstitial Gingivitis." The close reading by dentist and student is recommended for this chapter; indeed, it would be difficult to mention any chapter that would not be good and instructive reading.

The illustrations are excellent, each one being well described. There is also an index, that indispensable appendix to any book of reference. The book is printed on excellent paper in good readable type, and well bound. We wish it success.